

AGRICULTURAL RESEARCH IN IRAN

POLICY, INVESTMENTS, AND INSTITUTIONAL PROFILE

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ASTI Country Report**

In memoriam of Dr. Mohsen Mohsenin

**International Food Policy Research Institute
Agricultural Extension, Education and Research Organization**

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About the ASTI Initiative

The Agricultural Science and Technology Indicators (ASTI) initiative compiles, processes, and makes available data on institutional developments and investments in agricultural R&D worldwide, and analyzes and reports on these trends. Tracking these developments in ways that make for meaningful comparisons among different countries, types of agencies, and points in time is critical for keeping policymakers abreast of science policy issues pertaining to agriculture. The main objective of the ASTI initiative is to assist policymakers and donors in making better informed decisions about the funding and operation of public and private agricultural science and technology agencies by making available internationally comparable information on agricultural research investments and institutional changes. Better informed decisions will improve the efficiency and impact of agricultural R&D systems and ultimately enhance the productivity growth of the agriculture sector. The ASTI initiative is managed by the International Service for National Agricultural Research Division of the International Food Policy Research Institute (www.ifpri.org) and comprises a network of national, regional, and international agricultural R&D agencies. Primary funding for the ASTI initiative's survey round in Asia was provided by the World Bank and IFPRI core funding. ASTI data and associated reports are made freely available for research policy formulation and priority-setting purposes, and can be found at the ASTI website: www.asti.cgiar.org.

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ACRONYMS

AAARI	Artemia and Aquatic Animal Research Institute
AARINENA	Agricultural Research Institutions in the Near East and North Africa
ABRII	Agricultural Biotechnology Research Institute of Iran
AEERO	Agricultural Extension, Education and Research Organization
AERI	Agricultural Engineering Research Institute
AgGDP	agricultural gross domestic product
APAARI	Asia-Pacific Association Agricultural Research Institutions
APERI	Agricultural Planning and Economic Research Institute
AREC	Agricultural Research and Education Council
AREO	Agricultural Research and Education Organization
ARLSC	Agricultural Research and Laboratory Services
ASRI	Animal Sciences Research Institute
ASTI	Agricultural Science and Technology Indicators
BFIRC	Beverages and Fruit Juices Industrial Research Center
CACAARI	Caucasus Association of Agricultural Research Institutions
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Center for Maize and Wheat Improvement
EAANRRC	East Azerbaijan Agricultural and Natural Resources Research Center
FANRRC	Fars Agriculture and Natural Resources Research Center
fte	full-time equivalent
GDP	gross domestic product
GFAR	Global Forum for Agricultural Research
GSFARLS	Gharb Sugar Factories Agronomic Research and Laboratory Services Company
HCSRT	High Council of Science, Research and Technology
HSAIC	Haftapeh Sugarcane Agro-Industry Company
IANRRC	Agricultural and Natural Resources Research Center
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFRI	Iran Fisheries Research Institute
INSF	Iran National Science Foundation (Fund)
IRRI	International Rice Research Institute
IWMI	International Water Management Institute
JKARC	Jiroft and Kahrizkuch Agricultural Research Center
KANRRC	Khorasan Agricultural and Natural Resources Research Center
KSRAS	Khorasan Sugar Beet Research and Agronomic Services Company
MOJA	Ministry of Jihad-e Agriculture
MzANRRC	Mazandaran Agricultural and Natural Resources Research Center
OECD	Organisation for Economic Co-operation and Development
PFIRC	Pesticide and Fertilizer Industrial Research Center
PIRC	Pesticides Research Center of Agricultural Supporting Services Company

PPDRI	Plant Pests and Diseases Research Institute
PPP	purchasing power parity
R&D	research and development
RIFR	Research Institute of Forests and Rangelands
RVSRI	Razi Vaccine and Serum Research Institute
SAAHC	Sefidroud Agricultural and Animal Husbandry Company
SCWMRI	Soil Conservation and Watershed Management Research Institute
SPII	Seed and Plant Improvement Institute
SWRI	Soil and Water Research Institute
S&T	science and technology
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USRTS	Urmia Sugar Beet Research and Technical Services Company
WAANRRC	West Azerbaijan Agriculture and Natural Resources Research Center

ABSTRACT

This report presents an overview of Iran's national agricultural R&D system in terms of institutional developments and recent trends in human and financial resources based on data collected under the Agricultural Science and Technology Indicators (ASTI) initiative.

In 2004, close to 4,700 full-time equivalent (fte) scientists were involved in public agricultural research (that is, excluding the private sector) in Iran, which represented an 18 percent increase over levels recorded in 2000. Public agricultural research in Iran is largely conducted by the Agricultural Research and Education Organization (AREO), currently known as the Agricultural Extension, Education and Research Organization (AEERO). 44 percent of the country's agricultural scientists were employed at one of 32 AREO-affiliated provincial research centers, while another one-third were employed at one of AREO's 24 national research centers. These provincial government agencies are typically charged with all agricultural R&D within a particular province, while their national counterparts focus on one particular commodity or discipline. Non-AREO government agencies and higher education agencies play only a modest role in public agricultural R&D in Iran, accounting for just 8 and 11 percent of total fte agricultural research staff in 2004, respectively.

In 2004, Iran invested \$432 million in public agricultural R&D (in 2000 constant prices), or 0.91 percent of the country's agricultural GDP. Iran rates well above some of its neighbors in the region in terms of the intensity of public-sector investment in agricultural R&D and average expenditures per researcher. The lion's share of the country's public agricultural R&D is financed, either directly or indirectly, by the Iranian government. The private sector's involvement in financing public-sector agricultural R&D is small; however, its role in conducting agricultural R&D is expanding. In 2004, 6 percent of Iranian agricultural R&D investments were made by the private sector, bringing Iran's total (public and private) agriculture R&D expenditures to \$457 million.

INTRODUCTION

Despite its declining importance as a contributor to the gross domestic product (GDP), agriculture still represents an important input to the national economy and to rural livelihoods in the Islamic Republic of Iran (hereafter, “Iran”). Iran has traditionally emphasized a system of self-sufficiency in agricultural production, but this goal is very hard to attain given a national population of about 70 million people, growing at about 1.5 percent per year (SCI 2007). As a result, Iran needs to increase its imports of food or to increase its production. It goes without saying that agricultural research and development (R&D) plays an important role in increasing food production, which makes it a priority for the Iranian government.

This report presents an overview of the Iranian national agricultural R&D system within the context of the country’s wider national science and technology (S&T) policy. Drawing on data collected under the Agricultural Science and Technology Indicators (ASTI) initiative (IFPRI–AERO 2004–06), the report focuses on institutional developments and recent trends in human and financial resources.

Macroeconomic Context

Iran has abundant natural resources. Almost one-tenth of the world's oil and one-fifth of its natural gas reserves are located in Iran. The country also has large mineral deposits.¹ The agricultural sector plays an important role in the Iranian economy as well. In 2005, for example, the sector accounted for 14 percent of GDP and 21 percent of the economically active population (CBI 2007). The agricultural sector was the fastest growing economic sector in Iran over much of the 1990s due to the construction of extensive irrigation schemes and the expanded production of export-based agricultural commodities such as dates, flowers, and pistachios. Nevertheless, successive years of severe drought during 1998–2001 have substantially held back agricultural output growth. As a result, agriculture’s share of GDP has fallen from one-quarter in the early 1990s to the aforementioned 14 percent in 2005.

Roughly 32 million hectares is potentially arable (18 percent of Iran's total surface area), but only 19 million hectares have been developed for agricultural production under

¹ These include cobalt, copper, gold, iron ore, lead, zinc, manganese, nickel, silver, and uranium.

rainfed or irrigated conditions. The remaining land has not been brought under cultivation due to harsh climatic conditions or lack of water resources for irrigation. During 2002/03, 16 million hectares was under cultivation (9 percent of the total surface area), and the rest of the land was left fallow (Ministry of Jihad-e Agriculture 2007). Some northern and western areas support rainfed agriculture, while others require irrigation for successful crop production. Iran's multiplicity of agroclimatic zones makes it possible to cultivate a diverse range of crops. Wheat, rice, and barley are the country's major crops. Other crops include maize, dates, citrus, apples, figs, pomegranates, melons, grapes, vegetables, cotton, sugar beets, sugarcane, pistachios, nuts, olives, spices, tea, tobacco, and medicinal and herbal plants.

Since 1979 (the year of the Iranian Revolution), commercial farming has gradually replaced subsistence farming as the dominant mode of agricultural production. However, small farmers with less than 5 hectares of land constitute almost 73 percent of the country's agricultural producers. In 2006, only 5 percent of farmers owned more than 20 hectares of land (SCI 2007).

Of the country's livestock, sheep are by far the most numerous, followed by goats, cattle, asses, horses, water buffalo, and mules. The raising of poultry for eggs and meat is prevalent, and camels are still raised and bred for use in transport in remote areas.

Iran's forests cover approximately 12 million hectares or 8 percent of total land. The largest and most valuable woodland areas are in the Caspian region, where many of the forests are commercially exploited for both hardwood and softwood purposes. Forest products include plywood, fiberboard, and lumber for construction and furniture industries.

Fishing is also important, and Iran harvests fish both for domestic consumption and for export as fresh, salted, smoked, or canned products. Sturgeon (supplying roe for caviar), bream, whitefish, salmon, mullet, carp, catfish, perch, and roach are caught in the Caspian Sea. More than 200 species of fish are found in the Persian Gulf, 150 of which are edible, including shrimp and prawns.

Science and Technology Policies and Investments

Strong empirical evidence indicates that high levels of R&D effort lead to high

productivity and eventually to increased economic performance (Cororaton 1999). The rapid economic growth achieved by certain Asian countries in the 1990s can be partially attributed to a rapid generation of knowledge and intellectual property, including new technologies. Developed countries tend to spend around 3 percent of their GDP on R&D. In most developing countries, this average is much lower. Pakistan leads the Islamic world with 1 percent, but most other Islamic countries are far behind. Iran spends about 0.5 percent of its GDP on R&D. Nonetheless, its spending levels are well above the average of around 0.2 percent for Islamic world as a whole (Brookings Institution 2005).

Iran is a good example of a country that has made considerable economic advances by focusing on education and training. Despite international sanctions in almost all aspects of research during the past few decades, Iranian scientists have produced cutting-edge science. Their publication rate in international journals has quadrupled over the past decade. Although this level is still low compared with developed countries, it puts Iran in the first rank of Islamic countries (Wikipedia 2006).

The High Council of Science, Research and Technology (HCSRT), headed by the President of Iran, is responsible for formulating policies, strategies, and overall guidance to S&T as well as planning and identifying national S&T priorities. The ministries of Science, Research and Technology; Health and Medical Education; Jihad-e Agriculture; and others, are all involved in the development of S&T and are represented at HCSRT meetings. A number of other public and private institutions involved in S&T are also members of HCSRT. Plans are under way to delegate more power to HCSRT so that it can assess the relative role that each sector plays in Iranian S&T and how government S&T funding can best be allocated. The goal is to increase public spending on S&T development to more than 1.5 percent of GDP in the near future. In 2007, total public funding allocated to S&T development was estimated at around US\$1 billion. The agricultural sector received about 20 percent of this total (unpublished data from the National Management and Planning Organization, 2007). Newly emerging technologies such as biotechnology, stem cell research, information technology, and nanotechnology are priority areas for public S&T funding, and in recent years significant progress has been made in the application of these new technologies.

THE ORGANIZATION OF IRANIAN AGRICULTURAL R&D

The Iranian agricultural research system includes a large number of scientific institutions under different ministries. The Agricultural Research and Education Organization (AREO) oversees the major share of government-led agricultural R&D. AREO has recently been renamed to Agricultural Extension, Education and Research Organization (AEERO).² In this study, Iran's system of agricultural R&D agencies is categorized as national and provincial research institutes affiliated with AREO, government agencies administered by bodies other than AREO, nonprofit agencies, higher education agencies, and private-sector agencies (see *Appendix A* for definitions and methodology).

Agricultural Research and Education Organization

Iran's national agricultural research system is coordinated by HCSRT. In turn, AREO is supervised by a board of trustees headed by the Minister of Jihad-e Agriculture. Other members include the Minister of Science, Research and Technology; the Head of the Environment Protection Organization; and the Head of the Management and Planning Organization. The board oversees AREO's performance, formulates policies, and approves the overall budget and regulations. AREO is headed by the Deputy Minister of Research and Education, supported by various deputies and directors at AREO headquarters. AREO's mission is to contribute to the enhancement of food security and the well-being of the people of Iran through research, training, and related activities that increase agricultural production, improve food quality, save biodiversity, and manage natural resources in a sustainable manner. AREO plays a critical role in the sustainable development of the agricultural sector through the generation of appropriate technologies for sustainable food, feed, and fiber production by its affiliated research institutes and centers. It also provides comprehensive information for optimal utilization of natural resources (AREO 2006). AREO, headquartered in Tehran, is responsible for general management, planning, evaluation, coordination, and international cooperation of 24 national agricultural research institutes and a network of 34 provincial agricultural research centers (see *Appendix C*).

² The information in this report relates to 2004. Therefore, the old name of the institute, AREO, will be used throughout the remainder of the text.

Institutional Categories

We identified 191 agencies involved in agricultural R&D in Iran, including a sizeable number of private-sector agencies (see *Appendix C* for a full list of agricultural R&D agencies included in the data analysis in this report). In 2004, these 191 agencies employed close to 5,000 full-time equivalent (fte) researchers and spent \$457 million (in 2000 international prices) or 710 billion Iranian rial (in 2000 constant prices) on agricultural R&D (Table 1).

Table 1—Composition of agricultural R&D expenditures and researchers, 2004

Type of agency	Total spending		Total Researchers (fte's)	Share		Agencies in sample ^a (number)
	2000 Iranian rial	2000 international (PPP) dollars		Spending	Researchers	
	(millions)			(percentage)		
<i>Government^b</i>						
Affiliated with AREO						
National research institutes	338,135.3	217.7	1,584.4	47.0	31.3	24
Provincial research centers	199,778.4	128.6	2,199.0	28.1	44.2	32
Subtotal	537,913.7	346.3	3,783.4	75.7	76.1	56
Affiliated with universities	6,032.0	3.9	64.1	0.8	1.3	6
Affiliated with ministries	49,670.0	32.0	307.0	6.9	6.1	11
Governmental agricultural production units (non-AREO)	376.4	0.2	1.9	0.1	0.0	2
Total government	593,992.1	382.4	4,156.3	83.6	83.6	75
Nonprofit	2,283.2	1.5	10.0	0.3	0.2	5
<i>Higher education^c</i>						
Governmental	66,498.8	42.8	471.4	9.3	9.3	54
Private	8,280.3	5.3	58.7	1.2	1.2	23
Total higher education	74,779.1	48.1	530.1	10.4	10.5	77
<i>Total public</i>	<i>671,054.3</i>	<i>432.0</i>	<i>4,696.4</i>	<i>94.5</i>	<i>94.4</i>	<i>157</i>
Business enterprises ^d	39,073.8	25.2	277.0	5.4	5.5	34
<i>Total public and private</i>	<i>710,128.1</i>	<i>457.2</i>	<i>4,973.4</i>	<i>100</i>	<i>100</i>	<i>191</i>

Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

^a See Appendix C for a list of the 191 agencies included in our survey sample.

^b Expenditures for a number of government agencies are estimates based on average expenditures per researcher at the remaining government agencies. Staff at the government agencies spent between 10 and 100 percent of their time on research, resulting in 4,156.3 fte researchers.

^c Expenditures for the higher education sector in our sample are estimates based on average expenditures per researcher at the government agencies. Staff at the higher education agencies spent between 5 and 30 percent of their time on research, resulting in 530.1 fte researchers.

^d Expenditures for the private enterprises in our sample are estimates based on average expenditures per researcher for the government agencies.

Financial data in the remainder of this report are provided in real values using GDP deflators and purchasing power parity (PPP) indexes taken from the World Bank (2006).³

National Government Institutes Affiliated with AREO

Twenty-four national government agencies are administered by AREO. Most of these are commodity oriented (for example, wheat, barley, corn, oilseed crops, sugar beet, rice, pistachio, citrus, date palm, cotton, fisheries, livestock), while others are either based on a particular discipline (for example, soil/water, plant pests and diseases, agricultural engineering, agricultural economics) or farming system (for example, drylands). While the provincial government agencies have a clear regional focus, the national government agencies have a clear orientation toward a commodity or discipline.

The Iran Fisheries Research Institute (IFRI) is one of the larger individual national government agencies in terms of agricultural research staff. IFRI's main objective is to conduct scientific and applied research to address issues related to aquatic organisms and their environment, conservation and rehabilitation of stock, and the sustainable use of aquatic bioresources in the country's territorial waters. The organization is headquartered in Tehran and has 13 provincial research centers and stations located across the country, each specializing in a particular fisheries-related field, such as caviar, cold and warm water fish, shrimp, and artemia (brine shrimp). In 2004, the agency employed 316 fte scientists spread over its headquarters and provincial research centers.

The Razi Vaccine and Serum Research Institute (RVSRI) in Karaj in Tehran province is Iran's largest national government agency in terms of agricultural R&D spending. The institute has more than 75 years of experience in research and production of a great variety of medical and veterinary vaccines and is regarded as one of the oldest and most reputed scientific research centers in the Middle East. In recent years, RVSRI

³ PPPs are synthetic exchange rates used to reflect the purchasing power of currencies, typically comparing prices among a broader range of goods and services than conventional exchange rates. Using PPPs as conversion factors to denominate value aggregates in international dollars results in more realistic and directly comparable estimates of agricultural research spending across countries than would result from the use of market exchange (see the appendix for further explanation).

has embarked on a far-reaching program to further expand the scope of its activities, especially in the area of biotechnology and recombinant vaccines. In 2004, the institute employed 100 fte researchers.

The Plant Pests and Diseases Research Institute (PPDRI) is the principal agency in Iran involved in research related to plant pests, diseases and weed control. In addition to its headquarters in Tehran, the institute operates a Plant Pests and Diseases Research Laboratory in Karaj and a Biological Control Laboratory in Amol. 136 fte researchers were active at PPDRI in 2004.

The Karaj-based Seed and Plant Improvement Institute (SPII) was founded in 1959 to make available improved cultivars of major agricultural and horticultural crops to farmers. In 2004, the agency's 102 fte researchers located in its headquarters in Karaj conducted plant breeding and agro-technical studies related to important agricultural and horticultural crops including wheat, barley, jute, oil seeds, corn, pulses, forage crops, vegetable crops, potatoes, and fruit trees. The national gene bank of Iran is operating under the umbrella of SPII. The institute traditionally supervised many national research projects through its affiliated departments and stations affiliated to the provincial agricultural research centers.

The Research Institute of Forests and Rangelands (RIFR) was established in 1968 to carry out research covering various disciplines, such as forests, rangelands, botany, medicinal plants, and combating desertification. The agency employed 89 fte researchers in 2004, located at the institute's headquarters, herbarium, botanical garden, and gene bank in Tehran and its research stations in Karaj and Dammavand.

The Agricultural Biotechnology Research Institute of Iran (ABRII) conducts research in genomics, plant physiology and proteomics, haploid breeding, microbiology, tissue culture and genetic engineering. In addition to research, the institute is also involved in technology transfer and licensing. ABRII is headquartered in Karaj and operates regional research centers in Isfahan, Tabriz, and Rasht targeting the country's central, western, and northern regions, respectively. In 2004, 101 fte researchers were active at ABRII spread over the institute's headquarters and regional research centers.

The remaining 18 national research institutes each employed fewer than 100 fte researchers in 2004. Although national research institutes such as the Soil and Water

Research Institute (SWRI), the Agricultural Engineering Research Institute (AERI), the Soil Conservation and Watershed Management Research Institute (SCWMRI), and the Animal Sciences Research Institute (ASRI) employ less than 100 fte's, they dispose of very well-established research divisions at the provincial research centers that are adequately staffed and equipped. They are also involved in supervising and funding large research projects with a nationwide scope.

Provincial Research Centers Affiliated with AREO

Iran is subdivided into 30 provinces. Each province hosts at least one provincial R&D agency affiliated with AREO and catering to the province's specific agroclimatic needs. Rather than focusing on a particular commodity or discipline, provincial government agencies are typically charged with the agricultural R&D need of the entire province. Due to geographical size or vast differences in agroecological conditions, three provinces host two provincial research centers.

The Khorasan Agricultural and Natural Resources Research Center (KANRRC) is the largest of the provincial government R&D agencies. Its 174 fte researchers are involved in various fields of agricultural and natural resources research in Khorasan province in northeastern Iran. Besides its headquarters in Mashhad, Torogh, KANRRC operates 11 research stations scattered across the province. Khorasan was Iran's largest province until it was subdivided to form three separate provinces in 2004 (Central, Northern, and Southern Khorasan). AREO is planning to establish new provincial research centers in the newly created Southern and Northern Khorasan Provinces. These two new centers will supervise and operate the relevant research stations previously established in the region. However, the Khorasan Central (Razavi) Research Center with its headquarters in Torogh will continue to remain the largest provincial research center in the country.

The Isfahan Agricultural and Natural Resources Research Center (IANRRC) employed 136 fte researchers involved in a variety of research programs, including seed and plant breeding, horticulture, plant pest and disease management, medicinal plants, range improvement, soil and water management, agricultural engineering, and animal science. The center consists of headquarters in Isfahan and 16 agricultural, animal, and

water preservation stations distributed over the central Iranian province.

The Fars Agriculture and Natural Resources Research Center (FANRRC) is responsible for the agricultural R&D needs of Fars province in southwestern Iran. The center's 133 fte researchers are divided over the headquarters in Shiraz and stations in Zarghan, Darab, Estahban, Kazeroon, Jahrom, Eghlid, and Neiriz. Field and horticultural crops, natural resources management, soil fertility, watershed management, irrigation, livestock, and agricultural engineering play an important role in the FANRRC research activities.

The 108 fte researchers employed at the West Azerbaijan Agriculture and Natural Resources Research Center (WAANRRC) have a similar research focus. In addition to headquarters in Uroumieh, where 80 percent of the center's research staff is based, WAANRRC operates seven additional research stations.

The East Azerbaijan Agricultural and Natural Resources Research Center (EAANRRC) concentrates on a wide range of research topics, including crops, natural resources, and animal science. In 2004, the agency employed 111 fte researchers, mostly based at the Khosroshahr headquarters.

91 fte researchers were active at the Mazandaran Agricultural and Natural Resources Research Center (MzANRRC). Two-thirds of the agency's research staff is based at the headquarters in Sari, and the remainder are based at one of the six research stations located across the province. Field and horticultural crops, forestry, livestock, and socioeconomic research all play an important role at MzANRRC.

The remaining 26 provincial government agencies each employed fewer than 100 fte researchers. With 20 fte researchers in 2004, the Jiroft and Kahnouj Agricultural Research Center (JKARC) is Iran's smallest provincial government agency in terms of agricultural research staff.

Other Government Agencies

Three other types of government agencies are involved in agricultural R&D in Iran: government agencies affiliated to universities, government R&D agencies directly affiliated with ministries (not through AREO), and governmental agricultural production units. Combined, these three institutional categories accounted for 8 percent of total

Iranian agricultural R&D staff and expenditures in 2004.

A number of universities have established independent research centers/institutes to carry out research on specified topics. These research centers do not grant university degrees but cooperate with colleges to support and help students carry out their theses or dissertations. Six government agencies affiliated to universities are involved in agricultural R&D. Combined, these six agencies employed 64 fte researchers in 2004. The largest of these agencies was the Artemia and Aquatic Animal Research Institute (AAARI) under Urmia University. Nineteen fte researchers were active at this institute in 2004.

The survey sample also includes 11 ministry-affiliated agencies that do not fall under AREO. In recent years, however, the government has reviewed the possibility of bringing these agencies under the AREO umbrella. The largest two agencies in this category are the Agricultural Planning and Economic Research Institute (APERI) and the Pesticides Research Center of Agricultural Supporting Services Company (PIRC), employing 103 and 49 fte researchers in 2004, respectively. APERI carries out macroeconomic research related to agriculture and it assists political decision makers with (agro) economic matters. PIRC is mainly involved in agrochemical research on pesticides and fertilizers. The remaining agencies in this category each employed 27 fte researchers or fewer. These agencies fall under a number of different ministries, including the Ministry of Roads and Transportation; the Ministry of Commerce; and the Ministry of Science, Research, and Technology (MORST).

In addition, two public agricultural production units are involved in adaptive agricultural R&D in Iran: the Sefidroud Agricultural and Animal Husbandry Company (SAAHC) and the Hafttapeh Sugarcane Agro-Industry Company (HSAIC), both under the Ministry of Jihad-e Agriculture (MOJA). However, the number of research staff working at these two units was negligible. In 2004, SAAHC and HSAIC combined employed 1.9 fte research staff.

Higher Education Agencies

Compared with many developing countries around the world, the higher education sector in Iran accounts for a relatively small share of total agricultural R&D staff and

expenditures. Despite the large number of higher education agencies involved in agricultural research in Iran, the individual capacity of the majority—in terms of fte researcher numbers—is very small. Faculty staff at the majority of higher education agencies spend only a small share of their time on research; teaching is still the main activity for most. The total 471 fte researchers involved in research activities and technology development at the 54 government universities is about 9 percent of the total fte researchers in Iran. A distinction can be made between government universities and a large network of units under the Islamic Azad University, a private university. Islamic Azad University, which was established in the early 1980s, operates as a nonprofit and nongovernmental institution under the overall supervision and guidance of its own Board of Trustees. The University has established many semiautonomous branches around the country and plays an important role in higher education in a number of disciplines, including basic and human sciences, medicine, engineering, and agriculture. Research investments by the Islamic Azad University have been on the rise in recent years, but they still lag behind the government-funded universities, particularly in agriculture.

With 37 fte researchers in 2004, the Faculty of Agriculture of Tehran University, also known as Karaj College, is Iran's largest higher education unit involved in agricultural R&D. The faculty offers undergraduate and graduate programs (MSc and PhD) in various fields at 6 academic centers and 10 departments. Research staff focuses mainly on crops, horticulture, livestock, machinery, soils, water, and socio-economic themes. In 2005, a decision was made by Tehran University to merge the College of Agriculture and the College of Natural Resources in Karaj to form a unified Agriculture and Natural Resources Campus with five different colleges. The primary objective of this restructuring was to strengthen collaboration among different training departments and colleges located in Karaj. The merger of the two colleges resulted in a single higher education agency with an estimated total of more than 60 fte agricultural scientists.

The Faculty of Agriculture of Ferdowsi University in Khorasan province is the second largest higher education unit in the country involved in agricultural R&D in Iran. In 2004, it employed 34 fte research staff. The faculty was established in 1973 and now consists of 10 different departments that offer BSc, MSc, and PhD training. The faculty's research staff mainly concentrates on crop, livestock, horticulture, and postharvest, soil

and water research. The remaining 52 units under the government universities are located across the country; each employed fewer than 30 fte researchers in 2004.

Though researcher totals under the 23 units of the Islamic Azad University have shown a rapid increase in recent years, none of the units employed more than 10 fte agricultural researchers in 2004.

Nonprofit and Private-Sector Agencies

Five nonprofit agencies conducting agricultural research were identified in Iran, accounting for a negligible share of total agricultural research staff and expenditures in 2004. The nonprofit agencies included in the survey sample are the Beverages and Fruit Juices Industrial Research Center (BFIRC); the Khorasan Sugar Beet Research and Agronomic Services Company (KSRAS); the Agricultural Research and Laboratory Services (ARLSC); Isfahan, Naghshejahan, Chaharmahal-Bakhtiari, Ghazvin, Shirvan, and Shahzand Sugar Companies; the Urmia Sugar Beet Research and Technical Services Company (USRTS); and the Gharb Sugar Factories Agronomic Research and Laboratory Services Company (GSFARLS). Combined, these five agencies employed 10 fte agricultural research staff in 2004.

Thirty-four business enterprises involved in agricultural research were identified in Iran, but most of these companies employed only a few fte researchers (see the discussion of private-sector agricultural R&D in Iran presented later in this report).

Linkages and Cooperation

Although the AREO-affiliated agencies are autonomous entities under MOJA, reasonably close linkages exist among the various agricultural research institutes and the executive branches of ministries and development agencies. Until recently, research priorities were not strongly reflected in the National Development Program. However, great progress has been made in re-directing agricultural research to meet Iran's agricultural development needs. In 2003–04, MOJA launched a number of large-scale national projects with a view to increasing wheat, oilseed crops, and maize production, as well as improving the efficiency of water use. The research institutes affiliated with AREO work closely together and played an active role in developing national self-sufficiency plans for these

crops and for water use. The rapid growth of total agricultural production in recent years is indicative of the relatively close collaboration between the research and the executive branches. Nevertheless, a lot remains to be achieved, particularly in the area of natural resources management (that is, soil, water, biodiversity, forestry and range management), as well as in the areas of food health, waste management, postharvest technology, and reducing agricultural losses.

Collaboration among AREO research institutes and universities is generally limited to providing assistance to postgraduate students who make use of AREO laboratories and equipment. Some faculties, however, have stronger linkages with AREO centers as certain faculty staff participate in AREO projects. In recent years, AREO initiated memoranda of understanding (MOUs) with the Colleges of Agriculture of University of Tehran, Isfahan University of Technology, Mashhad Ferdowsi University, and others, in order to strengthen research partnerships and human resource development.

As mentioned previously, linkages with the international scientific community are limited. AREO, however, maintains close links with a number of international scientific institutions. Relationships between AREO and the centers of the Consultative Group of International Agricultural Research (CGIAR) have long been established. AREO is a member of the CGIAR and supports its affiliated international agricultural research centers. Strong linkages currently exist with the International Center for Agricultural Research in the Dry Areas (ICARDA), the International Center for Maize and Wheat Improvement (CIMMYT), and the International Water Management Institute (IWMI). These CGIAR centers operate regional offices in Tehran and Karaj. Collaboration between AREO and ICARDA concerns the improvement of agricultural production in the dryland areas of Iran, covering commodity research on a large number of crops, natural resource management, exchange of improved germplasm of ICARDA-mandated crops, as well as research capacity strengthening. AREO works closely with CIMMYT in the field of wheat, maize, and triticale germplasm research. Joint activities with IWMI involve research on water issues and the implementation of the Challenge Program on Water for Food in Karkheh River Basin in western Iran. AREO also collaborates with the International Rice Research Institute (IRRI)—on improved, high-yielding varieties of rice and on rice germplasm for resistance to salinity and to blast and other insects—and with

the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)—on research related to sorghum and chickpea germplasm, and on a program of breeding and plant protection under irrigated conditions. Other collaborative links exist with Bioversity International and the World Fish Center (Roozitalab et al. 1999).

AREO has strong linkages with the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA) and the Asia-Pacific Association Agricultural Research Institutions (APAARI) and their affiliated agricultural R&D networks. AREO hosts and supports the secretariats of the Regional Agricultural Information System of AARINENA and the Interregional Network on Cotton in Asia and North Africa (INCANA), which is cosponsored by AARINENA, APAARI, and the Central Asia and Caucasus Association of Agricultural Research Institutions (CACAARI). AREO has also signed MOUs to strengthen collaboration with the national agricultural research institutes of India, Pakistan, Syria, Sudan, Cuba, Turkey, Oman, Tajikistan, Azerbaijan, Russia, and China. It has also developed a partnership with several overseas universities, such as Wageningen Agricultural University in the Netherlands. In addition, many Iranian universities maintain close linkages with universities abroad, particularly with universities in the United States, Canada, Australia, the United Kingdom, France, Germany, Belgium, and the Netherlands. Each year, numerous scientific staff employed at Iranian universities take their sabbaticals at these universities.

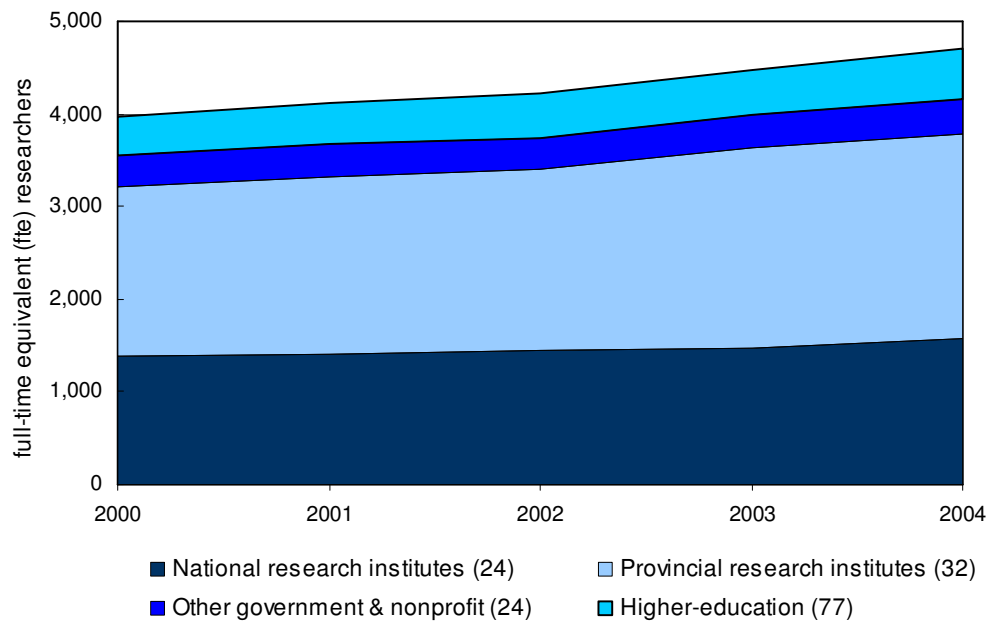
HUMAN RESOURCES IN PUBLIC AGRICULTURAL R&D

During the period 2000–04, total public agricultural research staff numbers in a 157-agency sample, excluding private for-profit companies involved in agricultural R&D, grew at an average rate of 4.3 percent per year, from 3,971 to 4,696 fte's (Figure 1). Growth for the national research institutes was 3.2 percent per year, on average, while the corresponding rate of the higher education sector as a whole was 5.4 percent, largely due to a rapid increase in the total number of research staff at Iran's private universities.⁴ Research staff at these private universities grew by an average of 11.0 percent per year during 2000–04. However, this steep rise was the result of an extremely small staffing

⁴ Private sector higher education agencies are classified as higher education agencies following the institutional classification in the Frascati Manual (see OECD 2002).

base in 2000. Private universities are typically understaffed, and their ratio of teaching staff to students is well below ratios recorded at public universities. The private universities have recently adopted a policy to strengthen their staffing through recruitment of more scientists with PhD degrees.

Figure 1—*Composition of public agricultural researchers, 2000–04*



Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2005–06).

Notes: See Table 1. Figures in parentheses indicate the number of agencies in each category. Underlying data are available at the ASTI website (www.asti.cgiar.org).

The institutional composition of public agricultural research staff in Iran did not show an important shift during the 2000–04 timeframe. The share of the national agricultural research institutes in fte researchers remained relatively stable at about one-third. Similarly, the share of the provincial research institutes remained relatively unchanged just above the 45 percent mark. At an average of 11 percent of total fte staff during 2000–04, the higher education sector plays a relatively minor role in agricultural R&D in Iran.

Rather than looking at the R&D size from an institutional perspective, it can also be analyzed according to the distribution across research agencies. The distribution of the 157 R&D agencies in the sample is skewed toward agencies with fewer than 10 fte researchers: more than 40 percent of the agricultural agencies fall in this category (Table

2). Most national and provincial research institutes, however, employ between 20 and 49 fte researchers. In 2004, just two agricultural research agencies employed more than 200 fte researchers, and 11 agencies employed between 100 and 200. The largest agency in the sample was IFRI, along with its affiliated provincial fishery research centers, which employed 316 fte researchers in 2004. The individual capacity of the majority of higher education units remains very small. Close to half of the government university units—many being university faculties and departments—and nearly all private university units employed fewer than 5 fte researchers.

Table 2—Size distribution of agricultural R&D agencies, 2004

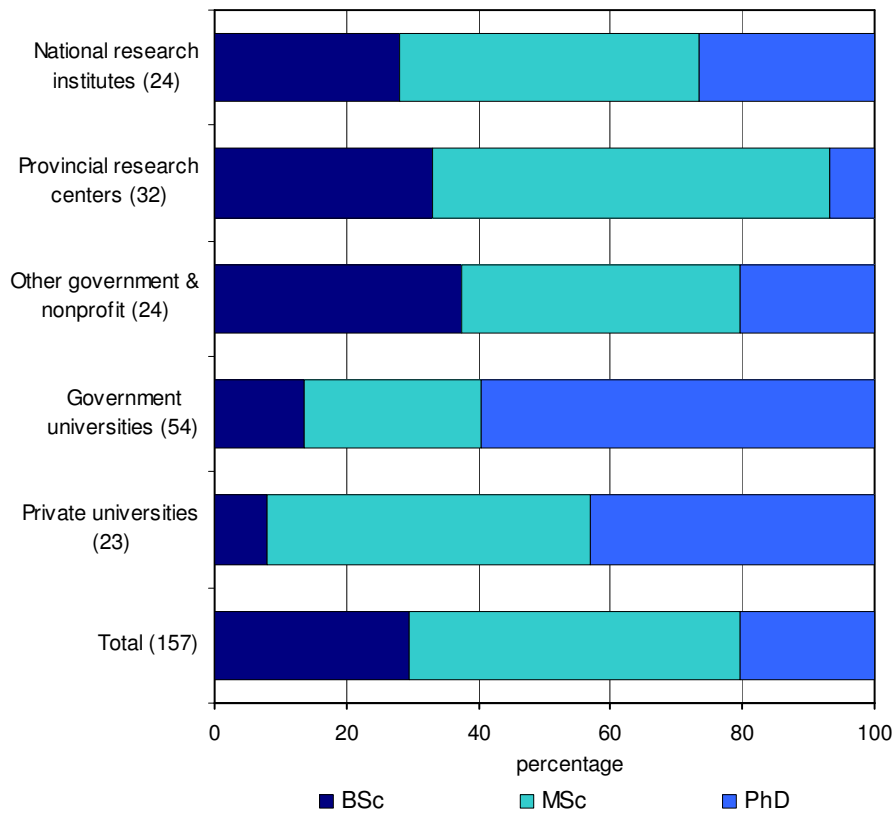
Number of fte researchers	National research institutes	Provincial research institutes	Other government agencies	Nonprofit agencies	Government universities	Private universities	Total
				(number)			
Fewer than 5	0	0	4	5	24	21	54
5–9	0	0	2	0	10	2	14
10–19	4	0	8	0	12	0	24
20–49	10	14	4	0	7	0	35
50–99	4	12	0	0	1	0	17
100–200	5	5	1	0	0	0	11
More than 200	1	1	0	0	0	0	2
<i>Total</i>	<i>24</i>	<i>32</i>	<i>19</i>	<i>5</i>	<i>54</i>	<i>23</i>	<i>157</i>

Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

Degree Status

In 2004, 21 percent of the 4,741 fte researchers in the 157-agency sample of public agricultural R&D agencies held a PhD degree, 50 percent held a MSc degree, and 29 percent held a BSc degree (Figure 2). The Iranian share of researchers trained to the postgraduate level (MSc or PhD) is much higher than in other countries of the region, such as Jordan (61 percent) and Syria (25 percent) (Beintema et al. 2006a; Beintema et al. 2006b).

Figure 2—Educational attainment of research staff by institutional category, 2004



Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

Note: Figures in parentheses indicate the number of agencies in each category.

Overall, average degree levels of Iranian research staff improved throughout the 2000–04 period. In 2004, 71 percent of the researchers in the 157-agency sample held a postgraduate degree (MSc or PhD) compared with 66 percent in 2000. Worldwide, higher education agencies across developing countries consistently report higher shares of research staff with postgraduate degrees than do government agencies. Iran is no exception in this regard. In 2004, 87 percent of research staff at the higher education agencies held MSc or PhD degrees, compared with only 69 percent of staff at the government agencies. These averages, however, mask important category-specific differences. Although the private universities employed a larger share of research staff trained to the postgraduate level, the government universities employed a larger share of research staff with PhD degrees. In 2004, more than three-quarters of the researchers at 8 of the 54 government universities held PhD degrees, while none of the 23 private

universities reported such high shares of PhD-trained research staff. In the government sector, shares of staff trained to the PhD level varied widely across agencies as well. Eighty-five percent of researchers at RVSRI held MSc (doctor of veterinary) and PhD degrees in 2004. Less than 10 percent of the research staff at 39 of the 67 Iranian government agencies were trained to the PhD level.

AREO—with the support of MOSRT—has taken important measures to upgrade the qualifications of its existing research staff and to overcome the strong competition in university admission to MSc programs by improving the knowledge of its staff through training. This training was mostly funded by MOSRT and a number of international agricultural research centers such as ICARDA, CIMMYT, and IRRI. Since 1996, AREO has financially supported a large number of staff in undertaking PhD-level training at foreign universities. Such training is ongoing but at a reduced level.

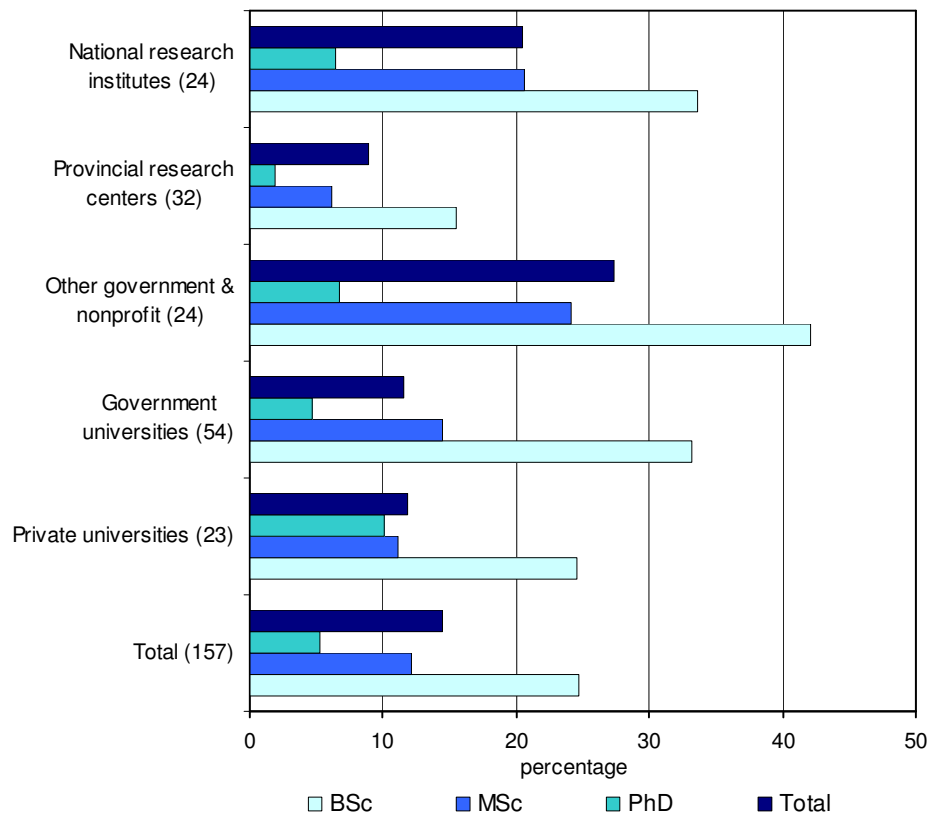
In 2004, for example, 95 AREO researchers were pursuing PhD training at foreign universities, mainly in Malaysia, the United Kingdom, India, Canada, and Australia. An additional 140 AREO researchers were enrolled in PhD programs at Iranian universities, notably the University of Tehran, Tarbiat Modarres University, Shiraz University, the University of Tabriz, Mashhad Ferdowsi University, and the Islamic Azad University (AREO 2005). AREO maintains a fund for staff training from which scholarships have been provided for the majority of the research staff studying abroad. AREO and its affiliated research institutes continually identify the research areas and locations where human resource development in the form of PhD-level training is most urgently needed; it also encourages MSc scientists to pursue PhD training in these fields. With managerial approval, all AREO researchers are entitled to take three years of paid leave for training purposes at random points in their careers. In addition, MOSRT regulations stipulate that, with the approval of their principal supervisor, PhD students at Iranian universities are entitled to spend six months of sabbatical leave in an accredited university abroad as part of their PhD dissertation. Many AREO staff have taken advantage of this opportunity spending sabbaticals at universities in Canada, Australia, the United Kingdom, and other countries. Ninety percent of trainees recently been trained abroad are reported to have returned to Iran upon completion of their education abroad. The higher education sector has similar regulations for MSc staff interested in pursuing

PhD training abroad; however, the policy of universities in recent years has been to recruit PhD-holders, which is the primary reason why the share of PhD staff working at universities is higher than the share at AREO research institutes.

Gender

Despite a rise in the number of women pursuing scientific careers worldwide, female researchers still tend to be underrepresented in senior scientific and leadership positions (Sheridan 1998). Iran is no exception in this regard. In 2004, based on the 157-agency sample, 14 percent of all researchers in Iran were female (Figure 3). During that year, 5 percent of the PhD-qualified researchers, 12 percent of those with MSc degrees, and 25 percent of those with BSc degrees were women. The share of female researchers in Iran is similar to the corresponding share in Jordan (13 percent) but lower than Syria's share (23 percent) (Beintema et al. 2006a; Beintema et al. 2006b). It is worth mentioning that the national research institutes employed a comparatively higher share of female researchers than their counterparts in the provinces or in the higher education agencies. It may be that many research institutes are headquartered in or near Tehran and therefore have more advanced research facilities and laboratories, where better working opportunities and living facilities are provided to female researchers and their dependents. The nonprofit institutions employed a particularly high share of female scientists (42 percent).

Figure 3—Share of female researchers, 2004

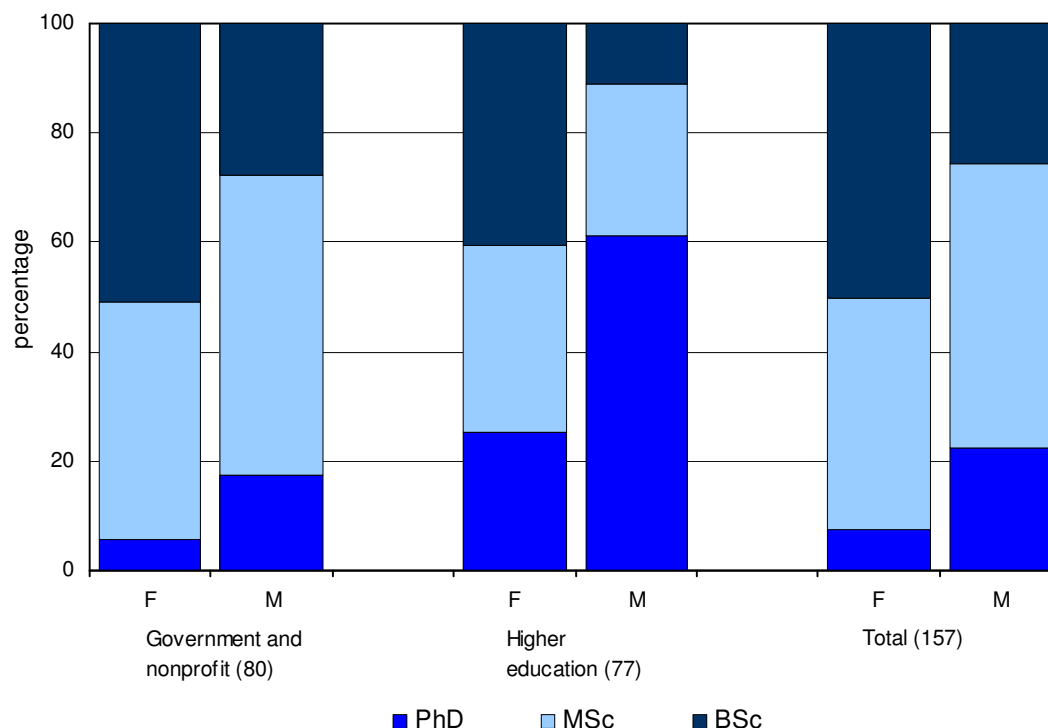


Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

Notes: Figures in parentheses indicate the number of agencies in each category.

Unsurprisingly, the share of female researchers with postgraduate degrees (MSc or PhD) is lower than the corresponding male share in all three subcategories. In 2004, 50 percent of all female researchers in Iran were trained to the postgraduate level, compared with 74 percent of male researchers (Figure 4). That year, the share of men holding PhD degrees (22 percent) was much higher than the corresponding share for women (7 percent); the share for women was also considerably lower than the average for the developing world as a whole. On average, 23 percent of female agricultural scientists in a sample of 67 African, Asian, and Middle Eastern countries held PhD degrees in 2000–03, compared with 35 percent of all male researchers (Beintema 2006). The gap between male and female research staff holding PhD degrees was particularly large in Iran’s higher education sector. In 2004, 61 percent of the male scientists in the higher education sector held a PhD degree compared with just a quarter of the female researchers.

Figure 4—Degree levels of male and female researchers, 2004



Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

Notes: Figures in parentheses indicate the number of agencies in each category. F indicates female, M male.

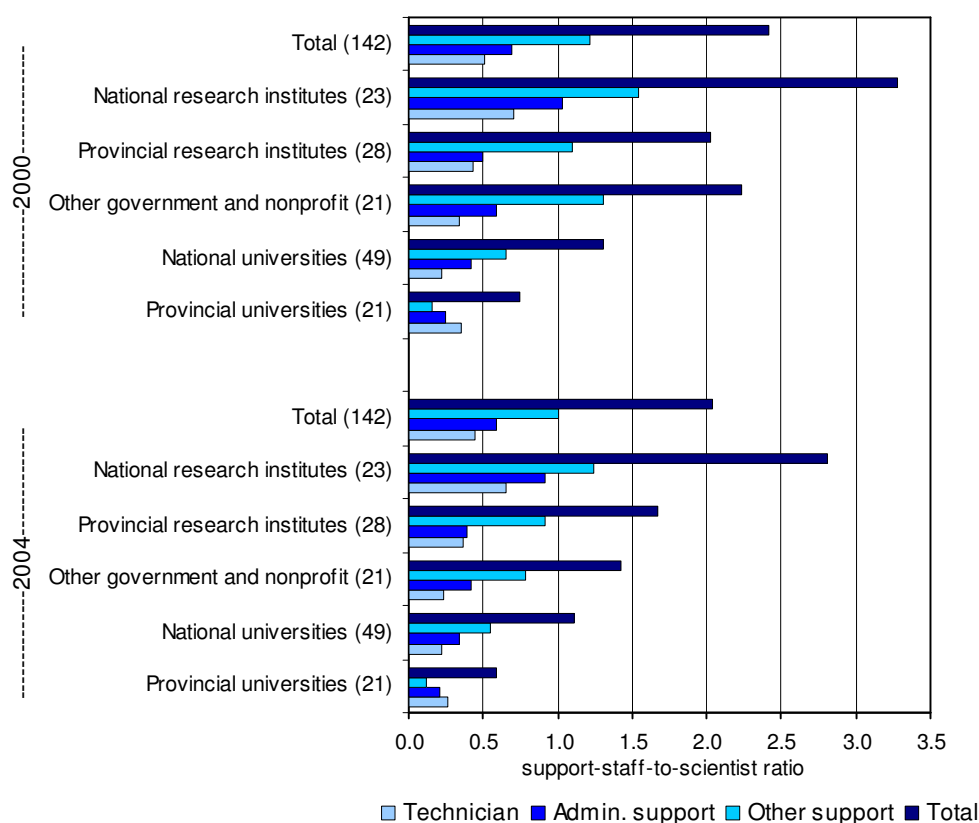
The female share of total agricultural research staff in 2004, at 14 percent, was considerably lower than the corresponding 37 percent share of female students enrolled in agricultural sciences at the higher education agencies that year (UNESCO 2006). In fact, the number of female students at numerous agricultural faculties surpasses that of men. The lower female research staff share reflects the difficulties women face in finding employment, especially in the government sector, once they complete their studies. Nevertheless, the number of female researchers has apparently increased over the past few years, especially in the private sector; this could, however, be the result of attempts made by companies to lower costs by hiring female staff at lower salaries than their male counterparts.

Support staff

In 2004, the average number of support staff per scientist in a 142-agency sample of public sector agencies was 2.0—comprising 0.4 fte technicians; 0.6 fte administrative

personnel; and 1.0 fte other support staff such as laborers, guards, drivers, and so on (Figure 5). This average support-staff-to-researcher ratio masks large variation between the various categories. In 2004, for example, the national research institutes under AREO employed 2.8 support staff per researcher, compared with just 0.6 support staff per researcher at the private universities.

Figure 5—Support-staff-to-researcher ratios, 2000 and 2004



Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

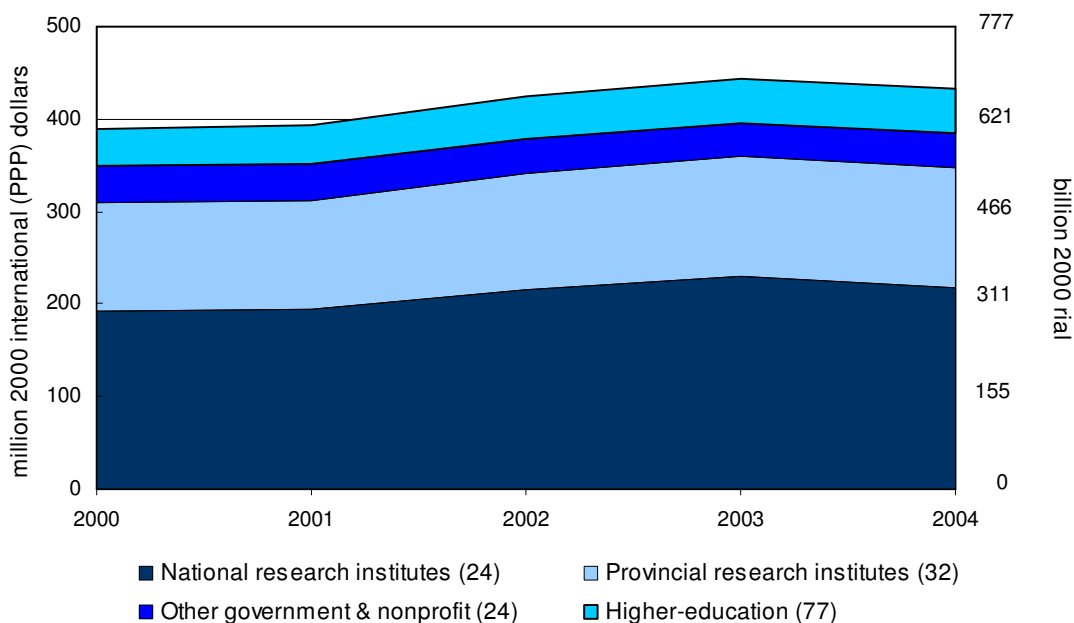
Notes: Figures in parentheses indicate the number of agencies in each category. The sample excludes 1 national research institute, 4 provincial research institutes, 3 other government and nonprofit agencies, 5 national universities and 2 provincial universities.

Support-staff-to-researcher ratios fell steadily during 2000–04. In 2000, the overall ratio for Iran’s public agricultural R&D agencies was 2.4 (compared with 2.0 in 2004). A decline in the number of support staff per researcher can be observed in all five subcategories but was most severe for the “other government and nonprofit agencies” category, where ratios fell from 2.2 in 2000 to 1.4 in 2004 as a result of a freeze on replacing retirees in support staff positions.

PUBLIC AGRICULTURAL R&D INVESTMENT TRENDS

Agricultural R&D investments for a 157-agency sample of Iranian public agricultural R&D agencies (excluding the private sector) grew steadily during 2000–04 at an average rate of 3.3 percent per year, from \$390 million to \$432 million in 2000 international prices (Figure 6). On average, growth was observed in all subcategories except the other government and nonprofit agencies combined, where a small decline in total agricultural R&D expenditures was reported for the 2000–04 period. This was mainly due to a sharp fall in spending at APERI—the largest agency in this category in terms of fte research staff and spending. This decline in spending was mainly due to the restructuring of APERI in combination of the completion of large projects on natural resources inventories and agricultural development plans for different regions. The latter was carried out by APERI in cooperation with private consultancy firms.

Figure 6—Composition of public agricultural R&D expenditures, 2000–04



Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2005–06).

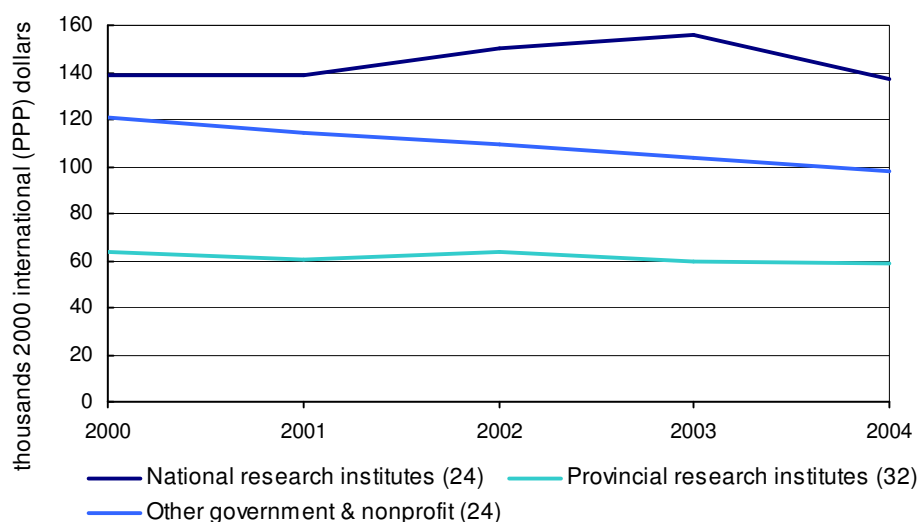
Notes: See Table 1. Figures in parentheses indicate the number of agencies in each category. Expenditures for the higher-education sector in our sample are estimates based on average expenditures per researcher at the government agencies. Underlying data are available at the ASTI website (www.asti.cgiar.org).

Disaggregating the specific categories, total agricultural research expenditures at seven government and nonprofit agencies more than doubled during 2000–04, while expenditures at three government agencies more than halved. At \$58 million, RVSRI was the national government agency with the highest agricultural R&D expenditures in 2004, followed by the Soil Conservation and Watershed Management Research Institute (\$36 million) and IFRI (\$26 million). The provincial government agencies spent a combined total of \$30 million that year.

Spending per Scientist

Agricultural R&D expenditures per researcher for an 80-agency sample of government and nonprofit agencies in Iran declined from \$98,000 in 2000 to \$92,000 in 2004 (Figure 7). Spending per researcher at the national research institutes averaged around \$144,000 during 2000–04, which was considerably higher than the corresponding levels at the provincial government centers (\$61,000) and the other government and nonprofit agencies (\$109,000). The higher spending per researcher at the national research institutes partly results from their function of providing technical support, organizing workshops and procuring research equipment at the provincial research centers. Average expenditures per researcher totaled \$580,000 at RVSRI given increased financial support from the government for infrastructure and facilities, including the construction of new laboratories and buildings for the production of vaccines.

Figure 7—Differences in levels of expenditure per researcher, 2000–04



Sources Figures 1 and 7.

Note: Figures in parentheses indicate the number of agencies in each category.

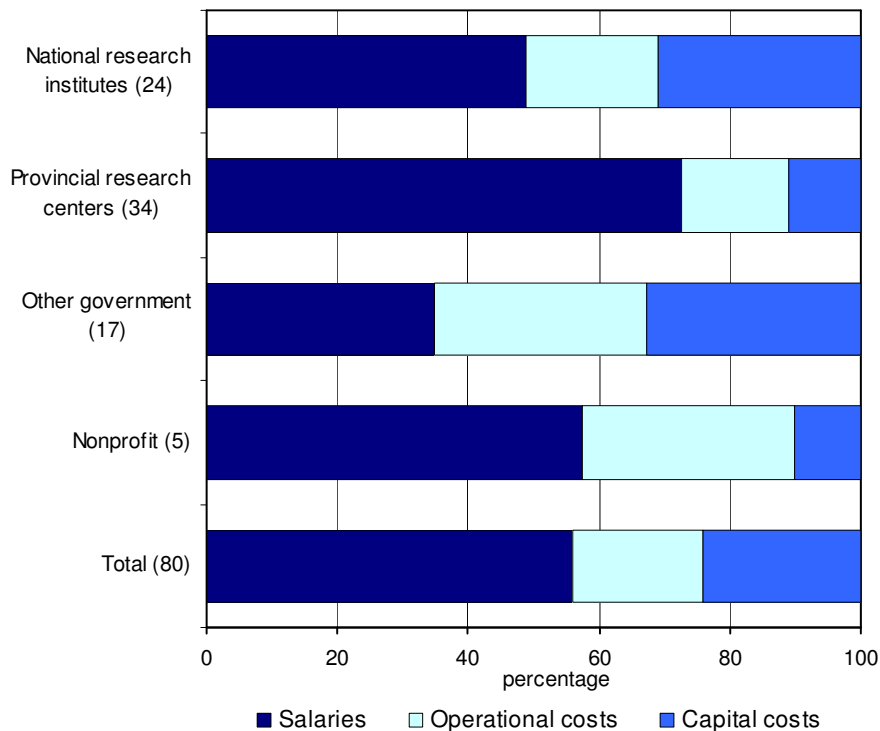
Cost Categories

The allocation of research budgets among salaries, operating costs, and capital costs affects the efficiency of agricultural R&D; hence, detailed cost-category data were collected as part of this study. In 2004, the 76 government agencies for which cost-category data were available spent 56 percent of their expenditures on salaries, 20 percent on operating costs, and 24 percent on capital investments. The cost structures for these agencies were comparatively stable over the 2000–04 period (Figure 8); however, large variation was observed across the different agency categories. In 2004, salaries represented roughly half the expenditures of the national AREO-affiliated agencies and close to three-quarters of expenditures at the provincial AREO-affiliated agencies. The national AREO agencies and the other government agencies spent close to one-third of their total budget on capital costs in 2004, while this category represented just 10 percent of expenditures by the provincial AREO-affiliated agencies and the nonprofit agencies.

Salary levels for research staff at government agencies and university faculties are generally comparable within the same geographic area, but research staff in remote areas are generally better paid than their Tehran-based colleagues. For example, agricultural research staff at AREO institutes and universities in Isfahan and Shiraz earn salaries up to

25 or 30 percent higher than their colleagues in Tehran. In more remote areas, the salary bonuses can add up to as much as 100 percent, even though the cost of living in these areas is generally much lower than in Tehran.

Figure 8—Cost-category shares in government and nonprofit agencies' expenditures, 2004



Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

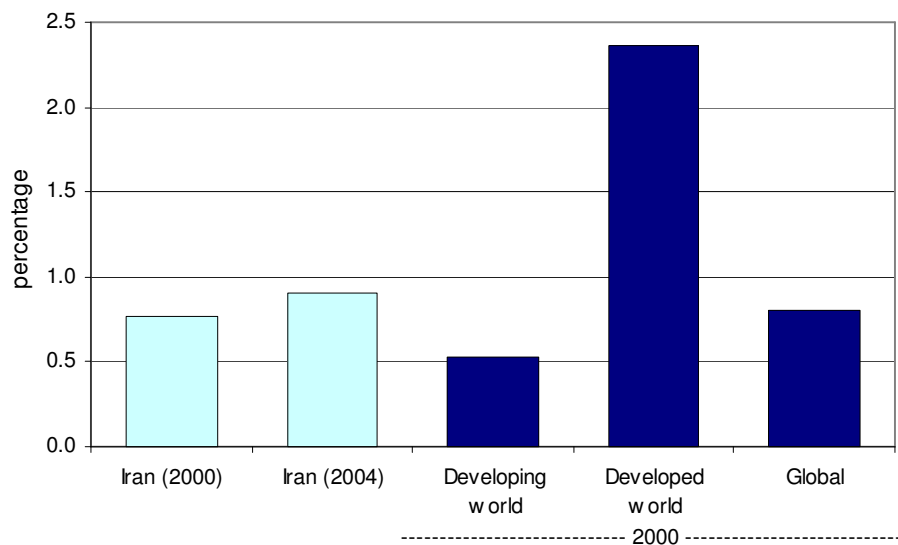
Note: Figures in parentheses indicate the number of agencies included in each category.

In past years, inflation-adjusted salary levels have fallen steadily in Iran. In order to adjust for this decrease, salaries for research and support staff underwent a one-time increase of 30 to 40 percent in 2005. As of January 2008, salaries of research staff with MSc and PhD degrees ranged between US\$12,000 and 30,000 per year, depending on degree level, location, and position. As a result, the share of salary costs in total expenditures of many AREO agencies increased to more than 85 percent. The reduction in the ratio of operational funds to total expenditures has recently led to difficulties for many research institutes in carrying out more research projects as well as equipping their research laboratories.

Intensity Ratios

Total public spending as a percentage of agricultural output (AgGDP) is a common research investment indicator that helps to place a country's agriculture R&D spending in an internationally comparable context. The public-sector intensity ratio for Iran was 0.91 percent in 2004 (Figure 10). If private-sector agricultural R&D investments were included, the 2004 intensity ratio would increase to about 0.96 percent. Iran's 2004 investment intensity ratio in agricultural research was higher than in other countries in the region such as Syria (0.53) and Pakistan (0.31), but lower than in Jordan (2.83), which experienced a rapidly decreasing AgGDP in recent years due to declining rainfall levels, rather than a boost in agricultural R&D spending (Beintema et al.2006b; Beintema et. al. 2006c; Beintema et al. 2006a). The 2004 ratio for Iran was well above the overall average for the developing world as a whole (0.53) and the global average (0.80) that year.

Figure 9—Iran's agricultural research intensity compared regionally and globally



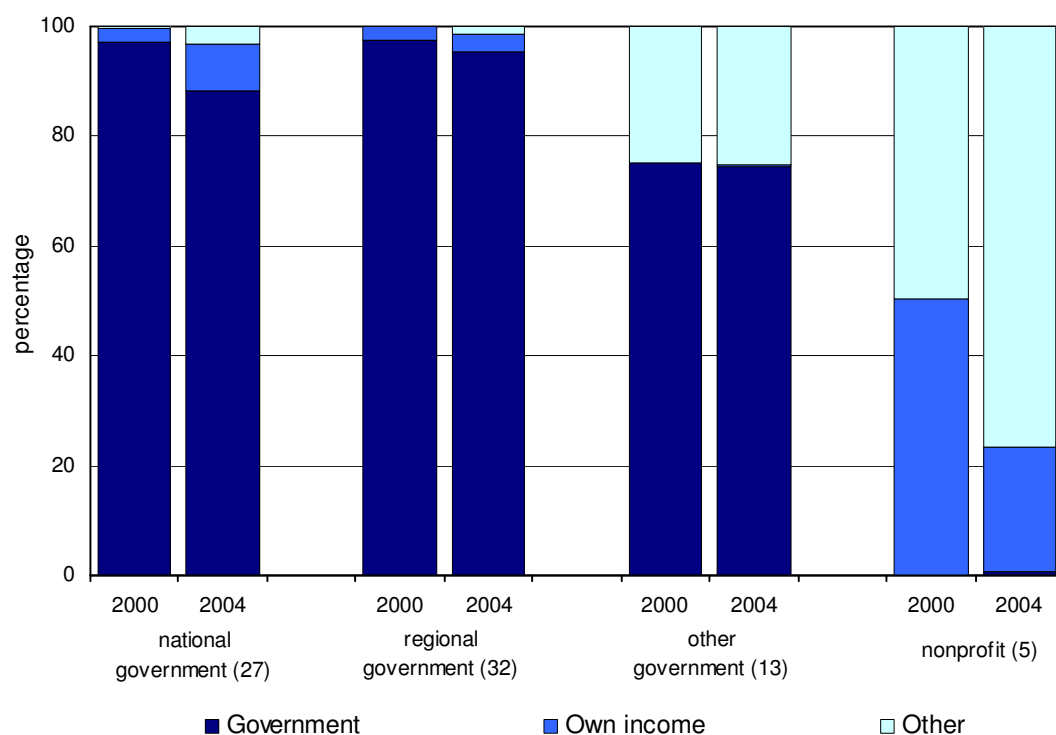
Sources: Iran compiled from Table 1 and Figure 6; AgGDP from World Bank (2006); developing world, developed world, and global from Pardey et al. (2006).

FINANCING PUBLIC AGRICULTURAL R&D

In recent years, funding for agricultural research in Iran has principally been provided by the national government, supplemented to a minor degree by internally generated resources and funds from the private sector. In 2004, 88 percent of the combined budget

of 71 government and nonprofit agencies was derived from the Iranian government, 6 percent was generated internally by agencies, and the remainder was raised by public and private enterprises. Negligible additional funding was contributed by foreign donors and international development banks (Figure 10). The relative share of government support in total agricultural R&D funding steadily declined during 2000–04. In 2000, the government supplied the funding for 94 percent of the expenditures incurred by the government and nonprofit agencies. Internally generated revenues, on the other hand, gradually gained prominence throughout this period. Upon the approval of AREO and the government, all income generated by the research institutes and provincial research centers, including the sale of agricultural produce and technologies, is returned to the relevant research units to be allocated for infrastructure improvements and other capital investments.

Figure 10—Funding sources of government and nonprofit agencies, 2000 and 2004



Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

Notes: Based on lack of available data, the Rural Research Center is excluded from the national government sample and Bushehr Agricultural and Natural Resources Research Center and Kermanshah Agricultural and Natural Resources Research Center are excluded from the provincial government sample. The other government category only includes agencies for which time series data were available.

The national research institutes and provincial government centers affiliated with AREO were much more dependent on government support than the other government agencies. During 2000–04, the nonprofit agencies combined received roughly 70 percent of their total funds from public/private enterprises and 30 percent was generated internally. Sugar beet research at KSRAS, for example, was entirely financed by the sugar industry.

The government allocation to the various research institutes and centers is directly disbursed as salaries and operating costs (about 90 percent of the total) while the remaining government allocation is disbursed in the form of competitive funding for research projects. The national research institutes receive all of their funding directly from Tehran, mostly through AREO, although a number of institutes receive funding from other ministries and units affiliated to the MOJA or HCSRT. Each year, the national and provincial AREO-affiliated research institutes submit funding proposals to AREO headquarters. After approval by AREO, the proposed budgets are passed on to the Iranian Parliament for review and approval in line with Iran's five-year Development Plan. After parliamentary approval, HCSRT reviews and allocates public research funding to the various ministries and organizations.

The provincial research centers also depend mostly on funding from Tehran (about 90 percent), but in addition receive some funding from the provincial government entities, mainly for projects addressing local problems. The government encourages the research institutes and centers to seek additional financial support from non-government sources such as the private sector, although the private sector has shown limited willingness to pay for agricultural R&D, mainly due to the predominance of smallholders in Iran, as previously mentioned. Recently, the Parliament agreed that all public (non-research) agencies should spend at least 1 percent of their current budget on research through contracts with universities and other research institutions. This decision has encouraged research institutes and universities to increase their collaborative endeavors; it is also likely to increase demand-driven research and significantly boost government investments in R&D in all sectors of the economy including agriculture.

In 2003, the Government of Iran established the Iran National Science Foundation (INSF), which provides grants to researchers at universities and research institutions to carry out interdisciplinary and multi-institutionary research; to patent innovations and technologies; and to scale up and market industrial research results. INSF is managed by the President's Office, has its own research council, and operates different technical committees to review and assess priorities and quality of the research proposals. The fund disburses sums of up to US\$100,000 per year to individual research projects. In 2007, the total value of research projects approved by the fund was about US\$5 million. Agricultural projects accounted for 19 percent of this total budget (INSF, 2007).

Funding for university-led agricultural research is also derived primarily from the Iranian government but through a variety of sources including direct university appropriations and funds from INSF and other government agencies, as well as from provincial government entities. Each province has its own S&T council and can financially support research proposals targeting local challenges. AREO's provincial research centers and universities in the province usually compete for R&D funding based on the priorities identified by the provincial government. The provincial funds, however, have not yet become a substantial and reliable source of research funding in Iran.

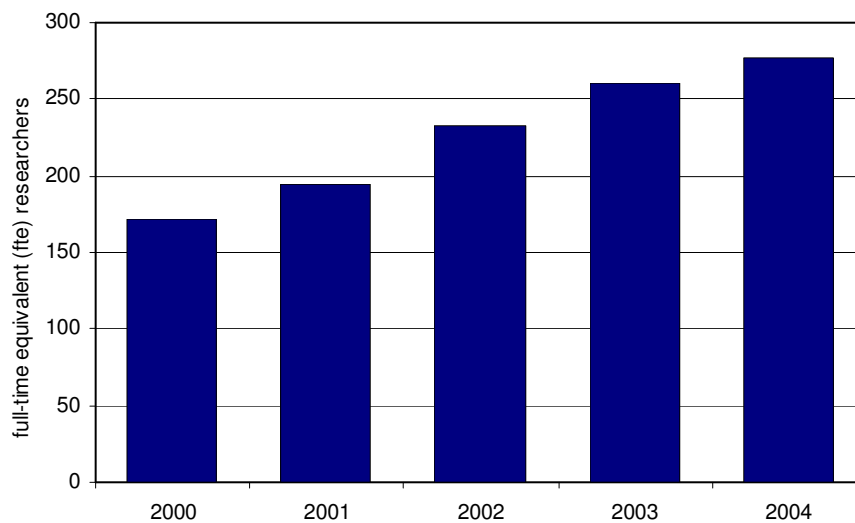
PRIVATE AGRICULTURAL R&D

The private sector accounts for only a small share of agricultural R&D conducted in Iran. Thirty-four private-sector agencies conducting their own research activities were included in our survey. Notably, much of the private research relates to quality control and testing and the research results are not accessible through publications, the Internet, or other means.

Agricultural research staff numbers in the Iranian private sector showed consistent growth during 2000–04 (Figure 11). Researcher totals for the 34 sample agencies rose by 62 percent to 277 fte's during this period, which was much higher than the overall growth in the public sector throughout the same period (18 percent). Despite this impressive growth rate, the overall share of private R&D staff rose only marginally, from 4 percent in 2000 to 5 percent in 2004. Unfortunately, time-series data on private agricultural R&D spending were unavailable. In 2004, however, it was estimated that the 34 sample agencies spent a combined total of around \$25 million (in 2000 international prices). Of

particular note is the high number of private-sector agencies involved in livestock research given the relatively limited contribution of livestock to agricultural GDP. Iran has a number of relatively large companies that produce, process, or market livestock products, and these companies have established small research units to support production and test quality.

Figure 11—Agricultural R&D staff in the private sector, 2000–04



Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

The Hashtgerd Premix Manufacturing Company (HASTH) is by far the largest private agency in Iran in terms of R&D spending. In 2004, this Tehran-based corporation accounted for 12 percent of the sample’s private agricultural research expenditures. That year, the company employed 11 fte researchers and spent \$3.2 million on agricultural R&D (down from \$20 million in 1996). HASTH manufactures a high-quality vitamin and mineral feed supplement for the livestock sector. Its R&D unit is widely regarded as a leader in premix research. Pak Dairy Company is Iran’s largest private R&D agency in terms of fte research staff. In 2004, the company employed 29 fte researchers, up from 20 fte researchers four years earlier. The company’s R&D unit was established in 1992, and its research staff is involved in many different kinds of dairy products including honey cream, honey milk, low lactose milk, and milk fortified with vitamin D3. The 25 fte researchers at the R&D unit of Jovin Agro-Industry in Sabzevar conduct a wide range of

activities, including crop (sugar beets, barley, tomatoes, grapes), livestock (sheep and goats, beef, and dairy), and fishery research. The unit was established in 1996, and its main goals are to increase production capacity and create new products. The R&D unit of Iran Dairy Industries (IDI) carries out dairy research in close collaboration with universities and government institutes. In 2004, IDI employed 17 fte research staff. Private R&D is also carried out by units under Teen Co., Shirin Khorasan Agro-Industry Company (SKAC), Mazandaran Wood and Paper Industries (MWPI), Isfahan Sugar Company (ISC), and Amol Meat Products Company (AMP). In 2004, each of these agencies employed between 10 and 15 fte researchers conducting a wide range of research activities focusing primarily on crop, livestock, and forestry research. The remaining 26 private-sector R&D units were relatively small, employing 10 fte or fewer in 2004.

Unlike a number of other countries, Iran's government does not have specific policies in place to stimulate private-sector participation in agricultural research. Moreover, no incentives are in place for private financing of public-sector agricultural research. The private sector has initiated research in specific areas that fall outside the public sector's mandate, the results of which are proprietary and hence not available in the public domain. These areas include food processing, high-value crops, and the adoption of imported seeds from abroad.

In recent years, the government has tried to encourage private-sector investment in agricultural R&D, such as in seed production, fertilizer use and production, plant pest and diseases management, food processing, and marketing. Nevertheless, Iran still lags behind other transition economies such as Argentina, India, Malaysia, and Turkey when it comes to private-sector involvement in agricultural R&D.

RESEARCH ORIENTATION

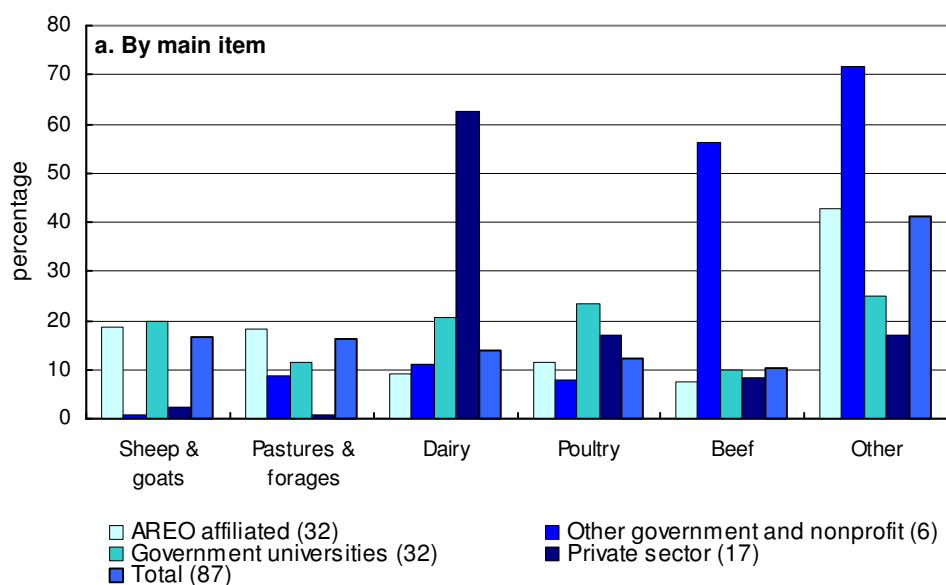
The allocation of resources among various lines of research is a significant policy decision, so detailed information was collected on the number of fte researchers working in specific commodity and thematic areas.

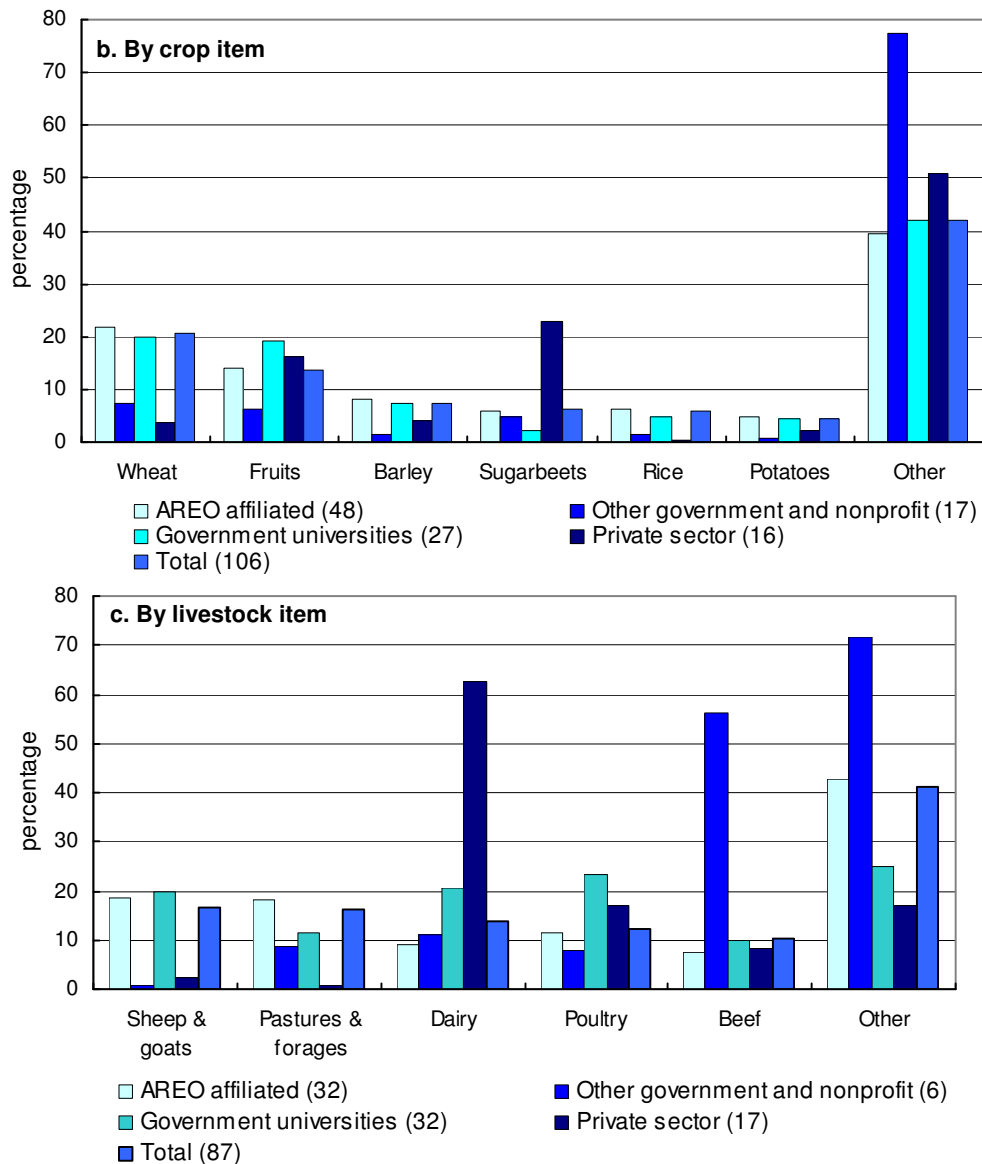
Commodity Focus

More than half of the 4,767 fte researchers in a sample of 157 agencies that includes the private sector conducted crop research in 2004 (Figure 12a). Livestock research accounted for 16 percent, natural resources and fisheries research for 9 percent each, and forestry research for 3 percent. Research staff at the AREO agencies spent relatively more time on crops than their counterparts at the other agency categories. Livestock research was prominent in the private and higher education sectors. The higher education agencies focused more on livestock research than their counterparts in other institutional categories. The unusually high share of researchers focusing on other research topics in the other government and nonprofit category stems from the high number of researchers focusing on pesticide research at the Pesticide and Fertilizer Industrial Research Center (PFIRC).

In 2004, of all the research conducted on crops, wheat accounted for roughly 20 percent, fruits for 14 percent, and barley for 7 percent (Figure 12b). Other important crops include sugar beets and rice, which accounted for 6 percent each. That same year, one in six livestock researchers focused on sheep and goats, 16 percent focused on pasture and forage, 14 percent focused on dairy, and 12 percent focused on poultry. One out of 10 livestock researchers focused on beef (Figure 12c). Notably, close to two-thirds of livestock researchers in the private sector concentrated on dairy research.

Figure 12—Commodity focus, 2004





Source: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06).

Notes: Figures in parentheses indicate the number of agencies in each category. Figure 12b only includes agencies involved in crop research; Figure 12c only includes agencies involved in livestock research.

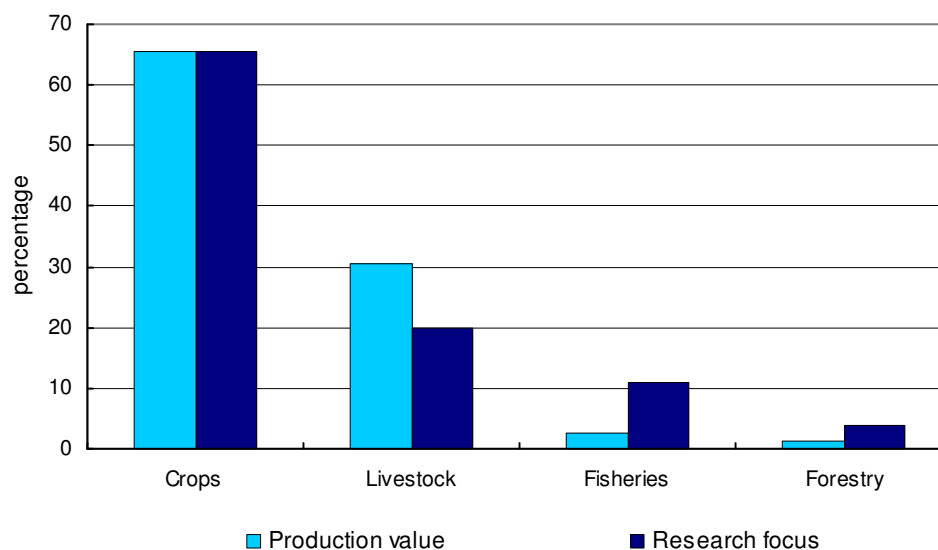
The congruency or parity model is a commonly used method of assessing the allocation of research resources. This usually involves allocating funds (or, in this instance research personnel) among research areas in proportion to their corresponding contribution to the value of agricultural production. For example, if the value of rice output were twice that of maize, then congruence would be achieved if research on rice

were to receive twice as much funding as maize (or employ twice as many scientists). The model assumes that an additional dollar spent on research would yield a higher return if spent in areas with a relatively low ratio of research funding to output value, therefore funds should flow toward programs with relatively low research intensities and from those with high research intensities. If research spending or scientist shares were congruent with the corresponding value of output for a particular commodity, then the congruency ratio for that commodity—measuring the commodity share of researchers to the corresponding share of output—would be equal to 1.0.⁵

Figure 13 shows the shares of crops, livestock, and fisheries in gross value of agricultural production along with the corresponding shares of research staff. In 2004, 66 percent of the researchers in a subsample, excluding natural resources and a few other minor research areas, undertook crop research—identical to the share of crops in the total value of production. In contrast, the share of livestock researchers was lower than its share in total production value, resulting in a congruency ratio of 0.6. The congruency ratios for fisheries and forestry were high at 4.3 and 2.9, respectively.

⁵ It is important to note, as Alston, Norton, and Pardey (1998) describe, that the model overlooks key factors affecting the payoff to R&D, such as the differences in probability of research success, likely adoption rates, and the likely extent of research-induced productivity gains. It also does not account for the spill-in of technologies from other countries or differences in the costs per scientists among different areas of R&D. So, although the congruence rule is a useful tool for allocating resources and a distinct improvement over precedence and some other shortcut methods, congruency ratios that differ from 1.0 are not necessarily a cause for concern.

Figure 13—Congruence between agricultural R&D and production value, 2004



Sources: Compiled by authors from ASTI survey data (IFPRI–AREO 2004–06). Production values are from Ministry of Jihad-e Agriculture (2007).

Notes: Postharvest and other research themes are not included.

Thematic Focus

In 2004, 14 percent of the 4,924 fte researchers in a 157-agency sample were working on crop genetic improvement, 12 percent on crop pest and disease control, and 16 percent on other crop-related themes (Table 3). The remainder of the researchers focused on livestock and natural resources-related themes, while only a small portion of researchers focused on postharvest, soil, and water themes. Research on crop genetic improvement was of relatively more importance for the government agencies than for the other two institutional categories. One-fifth of research staff at the 34 private-sector agencies focused on postharvest themes, compared to 1 percent at AREO. The share of fte researchers involved in socio-economic as well as policy research is very low both at government and private agencies.

Table 3—Thematic focus 2004

	AREO affiliated	Other government and nonprofit	Government universities	Private sector	Total
Number of agencies in sample	58	23	42	35	157
<i>Number of researchers:</i>					
			(in fte researchers)		
Crop genetic improvement	601.6	55.0	45.8	7.2	709.6
Crop pest and disease control	481.0	64.4	42.3	16.2	603.9
Other crop	634.0	54.8	62.1	27.7	778.5
Livestock genetic improvement	210.8	4.4	28.8	0.2	244.2
Livestock pest and disease control	180.6	6.4	59.5	9.7	256.2
Other livestock	286.2	27.1	59.9	42.5	415.7
Soil	249.7	23.1	38.2	6.4	317.3
Water	210.8	13.4	33.1	9.6	266.9
Other natural resources	313.9	6.9	25.7	5.9	352.4
Postharvest	58.2	11.3	19.1	55.5	144.1
Other	556.8	106.3	81.4	91.3	835.8
<i>Total</i>	<i>3,783.4</i>	<i>373.1</i>	<i>495.9</i>	<i>272.0</i>	<i>4,924.4</i>
<i>Shares by research theme:</i>					
			(in percentages)		
Crop genetic improvement	15.9	14.7	9.2	2.7	14.4
Crop pest and disease control	12.7	17.3	8.5	5.9	12.3
Other crop	16.8	14.7	12.5	10.2	15.8
Livestock genetic improvement	5.6	1.2	5.8	0.1	5.0
Livestock pest and disease control	4.8	1.7	12.0	3.5	5.2
Other livestock	7.6	7.3	12.1	15.6	8.4
Soil	6.6	6.2	7.7	2.3	6.4
Water	5.6	3.6	6.7	3.5	5.4
Other natural resources	8.3	1.9	5.2	2.2	7.2
Postharvest	1.5	3.0	3.8	20.4	2.9
Other	14.7	28.5	16.4	33.6	17.0
<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>

Source: Compiled by authors from ASTI survey data (IFPRI-AREO 2004–06).

CONCLUSION

In 2004, close to 4,700 fte scientists were involved in public agricultural research in Iran, which represented an 18 percent increase over levels recorded in 2000. Public agricultural research in Iran is largely conducted by the primary government agency, AREO (currently AEERO), or its affiliates. Forty-four percent of the country's agricultural scientists were employed at one of the 32 AREO-affiliated provincial research centers and one-third at one of AREO's 24 national research institutes or centers. These provincial government agencies are typically charged with all types of agricultural R&D in a particular province, while their national counterparts tend to focus on one particular commodity or discipline. Iran's 24 non-AREO government agencies and 77 higher education agencies play a more modest role in public agricultural R&D, accounting for just 8 and 11 percent of total fte agricultural research staff in 2004, respectively.

Public agricultural R&D expenditures in Iran also increased during 2000–04, albeit at slower growth rates than public research staff numbers. In 2004, the country invested \$432 million on public agricultural R&D (in 2000 constant prices), or 0.91 percent of the country's AgGDP. In terms of public-sector intensity of investment in agricultural R&D, Iran rates well above some of its neighbors in the region, such as Pakistan (0.31) and Syria (0.53). It should be noted, however, that roughly 85 percent of AREO's expenditures are currently allocated to salaries, which increased by 30 to 40 percent in 2005 in response to inflationary pressures. Importantly, operating expenditures (other than salaries) have decreased in absolute terms, representing a major challenge to many research institutes affiliated with AREO.

The lion's share of public agricultural R&D in Iran is financed directly or indirectly by the Iranian government. The role of the private sector in financing public-sector agricultural R&D is negligible; however, the private sector has become increasingly involved in conducting its own agricultural R&D. An estimated \$25 million was spent on agricultural R&D by the country's private sector in 2004, and agricultural research staff numbers in the private sector showed a steady increase during 2000–04. Of particular note is the high number of private-sector agencies involved in livestock research.

Iran's national agricultural research system is relatively well-staffed and it produces cutting-edge science. The country has outperformed many of its neighbors in terms of the average qualification levels of its research staff and its research expenditures per scientist. Nonetheless, Iran's food production needs to be increased to meet the needs of its rapidly growing population. Success in meeting this challenge will require the broad dissemination of new and improved technologies, sustained levels of funding for agricultural R&D, and government policies that stimulate and enhance public and private sector agricultural R&D.

REFERENCES

- Alston, J. M., and P. G. Pardey. 1999. The economies of agricultural R&D policies. Chapter 2 in *Paying for agricultural productivity*, edited by J. M. Alston, P. G. Pardey, and V. H. Smith. Baltimore: Johns Hopkins University Press.
- Beintema, N. M. 2006. Participation of female agricultural scientists in developing countries. Brief presented at *Women in Science: Meeting the Challenge* meeting, an adjunct to the CGIAR Annual General Meeting, Washington, D.C., December 4.
- Beintema, N. M., A. N. Fardous, and J. Alrusheidat. 2006a. *Jordan*. ASTI Country Brief No. 36. Washington DC: IFPRI and NCARTT.
- Beintema, N. M., M. Jamal, and M. Mwafak Mohammad. 2006b. *Syria*. ASTI Country Brief No. 35. Washington, D.C.: IFPRI and GCSAR.
- Beintema, N. M., W. Malik, M. Sharif, G. J. Stads, and U. Mustafa. 2006c. *Key trends in Pakistan's agricultural R&D investments*. IFPRI and PARC, Washington, D.C.
- Brookings Institution. Saban Center for Middle East Policy. 2005. Project on U.S. Policy Towards the Islamic World <http://www.brook.edu/fp/research/projects/islam/islamicworld20050105.pdf> (accessed November 2006). Washington, D.C.
- CBI (Central Bank of Iran). 2007. Statistics. <<http://www.cbi.ir/section/1372.aspx>> (accessed July 2007).
- Cororaton, C. B. 1999. R&D gaps in the Philippines. *Journal of Philippine Development*. 26 (2).
- FAO (Food and Agriculture Organization of the United Nations). 2007. FAOSTAT. <<http://faostat.fao.org/default>> (accessed January 2007).
- IFPRI–AREO (International Food Policy Research Institute and Agricultural Research, Education and Extension Organization). 2004/06. Agricultural Science and Technology Indicators (ASTI) survey for Iran. Unpublished surveys. IFPRI and AREO, Washington, D.C.
- INSF (Iran National Science Foundation). 2007. <<http://www.insf.org/IndexEn.php?>> (accessed July 2007).
- Ministry of Jihad-e Agriculture. 2007. Cultivation database. <<http://www.agri-jahad.ir/English/Statistic/Default.asp?p=statistic>> (accessed July 2007).
- OECD (Organisation for Economic Co-operation and Development). 2002. *Frascati manual: Proposed standard practice for surveys on research and experimental development*. Paris.
- Pardey, P. G., N. M. Beintema, S. Dehmer, and S. Wood. 2006. *Agricultural research: A growing global divide?* IFPRI Food Policy Report. Washington, D.C.: International Food Policy Research Institute.
- Roозitalab, M. H., A. Tehran Sharifi, M. Aghajani, and J. Tavakolian. 1999. The national agricultural research system of Iran. In *The national agricultural research systems in the West Asia and North Africa region*, J. Casas, M. Solh, and H. Hafez, eds. Aleppo, Syria: ICARDA, FAO, AARINENA, and CIHEAM.
- SCI (Iran Statistical Center). 2007. Population. <http://www.sci.org.ir/portal/faces/public/sci_en/sci_en.Glance/sci_en.pop> (accessed July 2007).
- Sheridan, B. 1998. “*Strangers in a strange land:*” *A literature review of women in science*. CGIAR Gender Program Working Paper No. 17. Boston, MA, and Washington, D.C.: Simmons Institute for Leadership and Change and CGIAR Secretariat.
- UIS (UNESCO Institute of Statistics). 2006. Education database. <<http://stats.uis.unesco.org/ReportFolders/reportfolders.aspx>> (accessed October 28, 2006).
- UNESCO (United Nations Educational, Scientific and Cultural Organization), Division of Statistics on Science and Technology. 1984. *Manual for statistics on scientific and technological activities*. UNESCO, Paris. Mimeo.
- World Bank. 2006. *World development indicators 2006*. Washington, D.C. CD-ROM.

APPENDIX A. ASTI METHODOLOGY AND DATA COLLECTION

The ASTI initiative involves a large amount of original and ongoing survey work focused on developing countries, but it also maintains access to relevant S&T data for developed countries collected by other agencies. The initiative maintains collaborative alliances with a number of national and regional R&D agencies, as well as international institutions and over the years has produced numerous national, regional, and global overviews and policy analyses of agricultural R&D investment and institutional trends. For each country in which ASTI is active, the research team typically works with the national agricultural research institute, which coordinates the in-country survey round and coauthors and co-publishes the resulting country briefs with IFPRI. These surveys focus on research agencies, not research programs.

The dataset for Iran's sample underpinning this report was processed using internationally accepted statistical procedures and definitions developed by the Organization of Economic Co-operation and Development (OECD) and the United Nations Educational, Science, and Cultural Organization (UNESCO) for compiling R&D statistics (OECD 2002; UNESCO 1984). Agricultural R&D investments are measured on a performer basis. Estimates were grouped into four major institutional categories: government agencies, higher education agencies, nonprofit institutions, and business enterprises. Public agricultural research is defined to include government agencies, higher education agencies, and nonprofit institutions, thereby excluding private enterprises. Government agencies are directly administered by the national government and are typically departments or institutes within a certain ministry. Nonprofit institutions, on the other hand, are not directly controlled by the national government and have no explicit profit-making objective. These agencies are often linked to producer organizations or commodity boards. Higher education agencies are academic agencies that combine university-level education with research. They include agricultural faculties as well as specialized R&D institutes placed under universities. Private-sector agencies are agencies whose primary activity is the production of goods and services for profit. Some of these companies have an R&D unit dedicated to agricultural research, but R&D is generally not their main activity. Agricultural research activities undertaken by international organizations are explicitly excluded from the dataset and are reported separately.

Agricultural research, as defined here, includes research on crops, livestock, forestry, fisheries, natural resources, the use of agricultural inputs, and the socioeconomic aspects of primary agricultural production. Also included is research concerning the on-farm storage and processing of agricultural products, commonly referred to as post-harvest or food-processing research. Not included in the current data compilation are research activities in support of agrochemical, agricultural machinery, or food processing industries (which are better reported under those industries), as well as the more basic and discipline-oriented research activities undertaken by departments such as microbiology and zoology. Strict delineations, however, have not always been possible.

A complete list of agencies involved in agricultural R&D was identified at the onset of the survey and each agency was approached to participate in the survey. To this end, three different survey forms were developed: one for government agencies and nonprofit institutions, one for faculties and schools, and one for the private sector. All forms had different sets of questions with the one for government agencies and nonprofit institutions requesting the most detail. In general the forms consisted of four sections:

- institutional details such as address, affiliation, organizational structure (including number of research stations), institutional history, and so on;
- human resource information, such as number of researchers by degree level, head count and full-time equivalents (that is, staffing adjusted for time spent on research), share of female researchers, and support staff by various categories;
- financial resources, such as expenditures by cost category and funding source; and
- research focus by commodity (about 35–40 items) and by theme (about 20 items).

Time series data were collected for the main indicators (research investments, research funding sources, and research staff totals); the remaining indicators were mostly for a particular benchmark year. Additional qualitative information was collected through country visits involving in-depth meetings with various agencies, given that quantitative information often doesn't provide the full picture of developments in agricultural R&D resources.

The reported research personnel data are expressed in full-time equivalent (fte) researchers. Researchers should hold at least a BSc degree or equivalent. Fte corrections were made only when more than 20 percent of the reported research staff time was spent

on activities other than R&D, such as extension, teaching, or technical services. The contribution of PhD students in research taking place at higher education agencies is usually not included.

Internationally Comparable Measures of R&D, Using PPPs

Comparing economic data from one country to the next is very complex due to important price level differences that exist between countries. Putting the agricultural R&D expenditures of two countries side by side is particularly difficult, given the fact that roughly two-thirds of research expenditures is typically spent on local research and support staff, rather than on capital or other goods and services, which are usually traded internationally.

The quantity of research resources used in economies with relatively low price levels tends to be understated when R&D spending is converted from different countries to a single currency using official exchange rates. Similarly, the quantity of resources used in countries with high price levels tends to be overstated. Purchasing power parities (PPP) are conversion rates that equalize the purchasing power of different currencies by eliminating the differences in price levels between countries. Therefore, a PPP rate can be thought of as the exchange rate of dollars for goods in the local economy, while the U.S. dollar exchange rate measures the relative cost of domestic currency in dollars. A country's international price level is the ratio of its PPP rate to its official exchange rate for U.S. dollars. Thus the international price level is an index measuring the cost of a broad range of goods and services in one country relative to the same bundle of goods and services in a reference country, in this case the United States. For example, Australia's international price level (that is, the ratio of PPP to exchange rate) of 0.77 in the year 2000 implies that the price of goods and services in Australia was 23 percent lower than the price of comparable goods and services in the United States during that year. In contrast, the corresponding 2000 ratio for Bangladesh of 0.22 indicates that a bundle of goods and services that cost \$22 in Bangladesh would have cost \$100 in the United States (Pardey et al. 2006).

No fully satisfactory method has so far been devised to compare consumption or expenditures between countries, either at different points in time or the same point in

time. The measures obtained, as well as their interpretation, can be highly sensitive to the deflator and currency converter used. Most financial figures in this report have been expressed in “international dollars” for the benchmark year 2000. At the country level, all expenditure and funding data have been collected in local currency units (Iranian rials). These amounts were subsequently converted to 2000 international dollars by deflating the local currency amounts with each country’s GDP deflator of base year 2000 and converting to U.S. dollars with a 2000 PPP index (both the GDP deflators and PPP values were taken from the World Bank 2006). For convenience of interpretation, the reference currency—in this case international dollars—is set equal to a U.S. dollar in the benchmark year 2000.

APPENDIX B. HISTORICAL PERSPECTIVES

Agricultural R&D in Iran dates back to the 1920s with the establishment of the Razi Institute in Karaj (Tehran province) in 1925 when the country was known as Persia. This institute—the predecessor of the current Razi Serum and Vaccine Research and Production Institute (RSVRI)—was charged with conducting R&D related to the production of animal vaccines and the eradication of veterinary diseases. In 1926, Iran's first agricultural college was founded in Karaj, (affiliated to the Ministry of Agriculture or MOA), and in 1933 the first college of veterinary medicine was opened in Tehran. Three agricultural research agencies were established shortly afterward: the Livestock and Animal Sciences Institute (Karaj, 1933, later known as the Animal Husbandry Research Institute, subsequently the Animal Sciences Research Institute), the Sugar Beet Seed Institute (Karaj, 1937, currently known as the Sugar Beet Research Institute), and the Iranian Tobacco Center.

The Iranian agricultural research and education system underwent important changes during the 1950s and 1960s. In 1955, the two colleges of agriculture and veterinary medicine mentioned above were transferred to the University of Tehran, and five additional agricultural colleges were created within newly established universities. In addition, a number of new agricultural research institutes were founded with financial and technical support from international agencies, including the Food and Agriculture Organization of the United Nations (FAO). One of these institutes was the Seed and Plant Improvement Institute (SPII). This Karaj-based institute was founded in 1959 and charged with research and seed multiplication for the country's main crops (cereals, oil crops, cotton, rice, horticulture, forages, and so on). Others include the Plant Pests and Diseases Research Institute (1962), the Soil Institute of Iran (1966), and the Research Institute of Natural Resources (1967).

The Iranian Parliament ruled in 1961 that most of the agricultural institutes existing at the time were to be officially established under MOA. Each institute maintained its autonomy and its own facilities and research projects in the different zones of the country. In 1975, the foundation for a coordinated agricultural R&D unit was put in place with the establishment of the Agricultural and Natural Resources Research

Organization (ANRRO). As a separate entity, this organization was charged with formulating policy and priority setting for all agricultural research institutes under its umbrella.

Iran's national agricultural research system further evolved after the revolution of 1979. A number of new institutes were established, including the Agricultural Economics Research Bureau in 1985 and the Agricultural Engineering Research Institute in 1988. In 1990, the newly founded Ministry of Jihad Construction (MOJC) took over responsibility for the agricultural research agencies charged with forest, range, and animal sciences (FRRI, RSVRI, ASRI), creating the Fisheries Research and Training Institute (FRTI, 1990) and the Soil Conservation and Watershed Management Research Institute (SCWMRI, 1993). Within MOA, ANRRO maintained responsibility for the crop-related research institutes and was merged with the Agricultural Education and Extension Directorate prompting the creation of the Agricultural Research, Education and Extension Organization (AREEO) in 1993. Since the formation of AREEO, a number of new research institutes have been founded. These included the Dryland Agricultural Research Institute (DARI), the Pistachio Research Institute (PRI), the Citrus Research Institute (CRI), the Rice Research Institute (RRI), the Date Palm Research Institute (DRI), and the Cotton Research Institute (CRI).

In 2001, MOA and the Ministry of Jihad Construction (MOJC) were remerged with the Ministry of Jihad-e Agriculture (MOJA). All agricultural research institutes were brought under the umbrella of the Agricultural Research and Education Organization, (AREO). The extension division was delegated to a new Deputy Minister for Extension and Land Use System within MOJA. But in October 2007, it was decided to remerge extension with AREO's research and training activities to create a newly restructured research, education, and extension body.

The number of agricultural colleges in Iran has shown tremendous growth over the past few decades to more than 75 agricultural colleges (and many junior colleges) spread throughout the country.

Source: Roozitalab et al. (1999).

APPENDIX C. GOVERNMENT AGENCIES, NONPROFIT ORGANIZATIONS, AND HIGHER EDUCATION AGENCIES

Type of Agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	Fte's
<u>Government</u>					
Central government	Agricultural Research and Education Organization (AREO)	Agricultural Biotechnology Research Institute of Iran	Biotechnology	101	101.0
		Agricultural Engineering Research Institute	Agricultural engineering	25	25.0
		Animal Science Research Institute	Livestock	84	84.0
		Date Palm and Tropical Fruit Research Institute	Date palm, fruits	17	17.0
		Dry Land Agricultural Research Institute	Dry land agriculture	44	44.0
		Engineering Research Institute	Machinery and engineering	294	29.4
		Iran Fisheries Research Organization	Fisheries	316	316.0
		Iran Citrus Research Institute	Citrus fruit	27	27.0
		Institute for Cotton Research	Cotton	33	33.0
		Iran Pistachio Research Institute	Pistachio	30	30.0
		International Sturgeon Research Institute	Fisheries	32	32.0
		National Salinity Research Center	Soil, water	12	12.0
		Plant Pests and Diseases Research Institute	Crops pests and disease , plant taxonomy	171	171.0
		Razi Vaccine and Serum Research Institute	Livestock	100	100.0
		Research Institute of Forest and Rangeland	Forestry, rangeland, medicinal plants, botany	112	112.0
		Rice Research Institute	Rice	53	53.0

Type of Agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	Fte's
Provincial government	Agricultural Research and Education Organization (AREO)	Rural Research Center	Socioeconomics	40	16.0
		Seed and Plant Certification Research Institute	Seed certification and registration	35	35.0
		Seed and Plant Improvement Research Institute	Crops	118	118.0
		Silkworm Research Institute	Silk worm, mulberry	11	11.0
		Soil and Water Research Institute	Soil, water	80	80.0
		Soil Conservation and Watershed Management Research Institute	Soil conservation and watershed management	66	66.0
		Sugar Beet Seed Research Institute	Sugar beet	30	30.0
		Tea Research Institute	Tea	42	42.0
		Ardebil Agricultural and Natural Resources Research Center	Potato, natural resources	66	66.0
		Azarbaijan Sharghi Agricultural and Natural Resources Research Center	Crops, livestock, natural resources, watershed management	124	124.0
		Bushehr Agricultural and Natural Resources Research Center	Crops, horticulture, natural resources	44	44.0
		Charmahal va Bakhtiary Agricultural and Natural Resources Research Center	Pastures and forages, nut, natural resource	42	42.0
		Fars Agricultural and Natural Resources Research Center	Crops, horticulture, livestock, natural resources	148	148.0
		Gilan Agricultural and Natural Resources Research Center	Crops, forestry	59	59.0
		Golestan Agricultural and Natural Resources Research Center	Crops, forestry, natural resources	82	82.0

Type of Agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	Fte's
		Hamedan Agricultural and Natural Resources Research Center	Potato , natural resources	68	68.0
		Hormozgan Agricultural and Natural Resources Research Center	Horticulture, natural resources	40	40.0
		Balouchestan Agricultural and Natural Resources Research Center	Crops, vegetables, natural resources	22	22.0
		Ilam Agricultural and Natural Resources Research Center	Crops, livestock, forestry	29	29.0
		Isfahan Agricultural and Natural Resources Research Center	Crops, horticulture, livestock, natural resources, forestry	156	156.0
		Kerman Agricultural and Natural Resources Research Center	Crops, natural resources	97	97.0
		Kermanshah Agricultural and Natural Resources Research Center	Crops, livestock, natural resources	58	58.0
		Khorasan Agricultural and Natural Resources Research Center	Crops, horticulture, livestock,, natural resources	205	205.0
		Khuzestan Agricultural and Natural Resources Research Center	Crops, natural resources, horticulture	73	73.0
		Kohgiluyeh va Boyerahmad Agricultural and Natural Resources Research Center	Crops, livestock, forestry, and rangeland	63	63.0
		Kurdistan Agricultural and Natural Resources Research Center	Wheat, barley, pastures and forages, natural resources	52	52.0
		Lorestan Agricultural and Natural Resources Research Center	Wheat, barley, livestock, natural resources	78	78.0

Type of Agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	Fte's
		Markazi Agricultural and Natural Resources Research Center	Natural resources, flowers, wheat	58	58.0
		Mazandaran Agricultural and Natural Resources Research Center	Wheat, fruits, natural resources	114	114.0
		Qazvin Agricultural and Natural Resources Research Center	Crops, livestock	42	42.0
		Qom Agricultural and Natural Resources Research Center	Natural resources, crops, livestock	22	22.0
		Semnan Agricultural and Natural Resources Research Center	Crops, natural resources, livestock	75	75.0
		Tehran Agricultural and Natural Resources Research Center	Natural resources, watershed management, livestock, crops	43	43.0
		West Azarbaijan Agricultural and Natural Resources Research Center	Crops, livestock	135	135.0
		Yazd Agricultural and Natural Resources Research Center	Horticulture, natural resources	45	45.0
		Zabol Agricultural and Natural Resources Research Center	Wheat, barley , vegetables	28	28.0
		Zanjan Agricultural and Natural Resources Research Center	Crops, natural resources	45	45.0
		Jiroft and Kahnouj Agricultural Research Center	Crops	20	20.0
		Safi Abad Agricultural Research Center	Crops	36	36.0
		Varamin Agricultural Research Center	Crops	30	30.0

Universities	Shahid Beheshti University	Medical Plant and Drugs Research Institute	Medicinal plant, drugs	8	2.4
	Yazd University	Desert and Dry land Research Institute	Natural resources, pastures and forages, forestry, socio-economics	17	11.9
	Tehran University	International Research Center for Living with Desert	Natural resources, socio-economics	13	7.8
	Urmia University	Artemia and Aquatic Animal Research Institute	Fisheries	19	19.0
	Shiraz University	Cereal Viral Diseases Research Center	Crops	8	8.0
	Ferdowsi University of Mashhad	Research Center for Plant Sciences	Plant science	15	15.0
Other Government	Meteorological Organization, Ministry of Road and Transportation	Atmospheric Science and Meteorological Research Center(	Atmospheric science	30	4.5
	Ministry of Commerce	Cereal and Bread Research Institute, Cereal Organization	Wheat	23	13.8
	Iranian Tobacco Company	Urmia Tobacco Research Center	Tobacco	10	10.0
		Tirtash Tobacco Research and Education Center	Tobacco	23	23.0
	Guilan Complex of Tobacco Ministry of Technology, Research and Sciences	Rasht Tobacco Research Station	Tobacco	17	17.0
		Agricultural Biotechnology Research Center, Scientific and Industrial Research Organization of Iran	Biotechnology	27	27.0
	Atomic Energy Organization of Iran	National Institute for Genetic Engineering and Biotechnology	Genetic engineering, biotechnology	45	15.8
		Nuclear Research Center for Agriculture and Medicine	Crops, livestock	27	18.9
		Pesticides Research Center of Agricultural Supporting Services Company	Pesticides	49	49.0
	Ministry of Jihad Construction and Agriculture				

		Agricultural Planning and Economic Research Institute	Socio-economics, natural resources	103	103.0
		Sefidroud Agricultural and Animal Husbandry Company	Dairy, poultry, fisheries	16	1.6
		Hafttapeh Sugarcane Agro-Industry Company	Sugarcane	5	0.3
	Sugarcane and Product Development Co.	Sugarcane Research Center, Sugarcane Development and Affiliated Industrials Company	Sugar cane	25	25.0
<u>Non profit</u>					
		Beverages and Fruit Juices Industrial Research Center	Post-harvest	6	1.2
	Fariman, Chenaran, Neyshabur, Shirin, Abkoh and Torbat-e-Heydarieh Suger Companies	Khorasan Sugar Beet Research and Agronomic Services Co.	Sugar beet	8	3.2
	Isfahan, Naghshejahan, Chaharmahal-Bakhtiari, Ghazvin, Shirvan, and Shahzand Sugar Companies	Agricultural Research and Laboratory Services	Sugar beet	7	3.5
	—	Urmia Sugar Beet Research and Technical Services Co.	Sugar beet	3	0.9
	—	Gharb Sugar Factories Agronomic Research and Laboratory Services Co	Sugar beet	3	1.2
<u>Higher education</u>					
Government	Tehran University	Faculty of Agriculture	Crops, natural resources, socio-economics	148	37.0
		Faculty of Natural Resources	Diverse	46	11.5
		Faculty of Veterinary Medicine	Veterinary Medicine	111	22.2
		Aboureyhan Agriculture Complex	Diverse	64	9.6

Isfahan University of Technology	Faculty of Agriculture	Crops, livestock, natural resources	107	26.8
	Faculty of Natural Resources	Diverse	31	4.7
Shiraz University	College of Agriculture	Crops, livestock, post-harvest	68	13.6
	School of Veterinary Medicine	Livestock	50	12.5
	Faculty of Agriculture and Natural Resources, Darab	Diverse	16	0.8
Ferdowsi University of Mashhad	Faculty of Agriculture	Livestock	134	33.5
	Faculty of Veterinary Medicine	Livestock	52	13.0
Urmia University	Faculty of Agriculture	Crops, livestock, natural resources	60	12.0
	School of Veterinary Medicine	Livestock	50	14.0
	Faculty of Natural Resources	Natural resources, forestry	3	0.2
Tabriz University	Faculty of Agriculture	Crops, livestock, post-harvest	124	24.8
	Faculty of Veterinary	Veterinary	8	0.4
	Maraghe Higher Education Complex	Plant protection, horticulture, socio-economics	27	1.4
Tarbiyat Modares University	Faculty of Agriculture	Crops, livestock, socio-economics	74	22.2
	Faculty of Natural Resources and Marine Sciences	Forestry, fisheries, socio-economics	36	9.0
Shahid Chamran University of Ahwaz	Faculty of Agriculture	Crops	57	14.3
	Faculty of Veterinary Medicine	Livestock	39	5.9
Ramin Agriculture and Natural Resources University	Faculty of Animal Sciences and Food Industries	Livestock	20	2.0
	Faculty of Agriculture and Natural Resources	Crops	22	2.2
	Faculty of Agricultural Engineering and Rural Development	Agricultural engineering, socio-economics	19	1.9
University of Guilan	Faculty of Agriculture	Crops, livestock,	67	10.1
	Faculty of Natural Resources	Forestry, silk worm, fisheries, environmental	41	6.2

—	Mazandaran Higher Education Complex of Agriculture and Natural Resources	Crops, natural resources	116	29.0
Gorgan Agricultural and Natural Resources University	Faculty of Agricultural	Crops, livestock, post-harvest, natural resources	80	12.0
	Faculty of Forest and Wood Technology	Forestry, wood science and technology, pulp and paper	27	2.7
	Faculty of Range and Watershed Management	Natural resources, fisheries	29	2.9
Shahid Bahonar University of Kerman	Gonbad Faculty of Agriculture	Crops, horticulture	43	2.2
	Kerman Faculty of Agriculture	Diverse	36	4.3
	Jiroft Faculty of Agriculture	Crops	24	1.2
	Faculty of Veterinary Medicine	Livestock	25	2.5
Boualisina University of Hamedan	Faculty of Agriculture	Crops, livestock, natural resources, socio-economics	58	8.7
Razi University of Kermanshah	College of Agriculture	Crops, livestock	66	11.9
	School of Veterinary Medicine	Veterinary medicine	12	0.6
Shahrekord University	Faculty of Veterinary Medicine, Shahrekord University	Livestock, post-harvest, fisheries	39	7.8
	Faculty of Agriculture	Crops, livestock, fisheries	59	11.8
Yazd University	Desert Studies and Natural Resources Faculty	Forestry, soil, water management, natural resources	29	5.2
Shah Rood University of Technology	Faculty of Agriculture	Wheat, natural resources	13	0.7
Zanjan University	Faculty of Agriculture	Crops, livestock	68	10.2
Kordestan University	College of Agriculture and Natural Resources	Crops, livestock, forestry	52	5.2
University of Rafsanjan	Faculty of Agriculture	Crops	17	1.7
University of Lorestan	Faculty of Agriculture	Crops	30	3.0
Shahed University	College of Agricultural Sciences	Rice, pastures and forages, natural resources, fisheries	22	1.1
Yasuj University	Faculty of Agriculture	N.A.	20	1.0

Private	Zabol University	Faculty of Agriculture	Crops, ostrich	88	13.2
	Mohaghegh Ardebili University	Faculty of Agriculture	Potato, beef, poultry	47	7.1
	University Semnan	School of Veterinary Medicine	Veterinary	12	1.2
	Birjand University	Faculty of Agriculture	Crops, livestock, natural resources	56	8.4
	Persian Gulf University	Faculty of Agriculture and Natural Resources	Fisheries, horticulture	19	1.0
	Hormozgan University	Department of Horticulture, Technical and Engineering Faculty	Horticulture	12	0.6
	Ilam University	College of Agriculture	Crops, livestock	30	3.0
	Islamic Azad University	College of Agriculture and Natural Resources, Tehran Unit (Science and Research)	Post-harvest, forestry, crops	66	9.9
		Faculty of Veterinary Medicine, Tabriz Unit	Veterinary	52	2.6
		Faculty of Agriculture, Isfahan Unit	Diverse	62	9.3
		Faculty of Agriculture, Mashhad Unit	Agronomy, socio-economics	17	0.9
		Faculty of Agriculture and Natural Resources, Arak Unit	Crops, livestock, natural resources, socio-economics	37	3.7
		Department of Agronomy and Plant Breeding and Department of Environmental Studies, Ardebil Unit	Agronomy, plant breeding, environmental	21	1.1
		Faculty of Agriculture, Arsanjan Unit	Diverse	29	1.5
		Faculty of Veterinary, Urmia Unit	Veterinary	26	2.6
		Department of Agriculture, Bojnourd Unit	Agronomy	16	0.8
		College of Agriculture and Natural Resources, Broujerd Unit	Natural resources	21	1.1

Faculty of Agriculture, Birjand Unit	Diverse	15	0.8
Department of Agriculture, Jahrom Unit	Horticulture, agronomy	25	1.3
Faculty of Agriculture, Khoy Unit	Diverse	16	1.6
Department of Agriculture, Zahedan Unit	Animal science, horticulture	14	0.7
Faculty of Agriculture, Saveh Unit	Diverse	44	2.2
Department of Agriculture, Sabzevar Unit	Diverse	27	1.4
Department of Animal and Veterinary Sciences, Shabestar Unit	Veterinary	43	2.2
Faculty of Veterinary, Shahrekord Unit	Veterinary	43	4.3
Department of Agriculture, Lahijan Unit	Fisheries, agronomy	25	1.3
Faculty of Agriculture, Miyaneh Unit	Agronomy, socio-economics, horticulture	32	1.6
Faculty of Agriculture and Natural Resources, Noshahr and Chaloos Unit	Diverse	31	3.1
Faculty of Agriculture, Neyshabour Unit	Diverse	13	0.7
Faculty of Agriculture, Varamin Unit	Diverse	90	4.5

Businesses

Mahram Company	R&D and Laboratories	Post-harvest	5
Amol Meat Products Company	R&D Department	Beef, poultry	11
KhormaBon-e Jonoub Company	R&D Unit	Dates	4
Pakdis Company	R&D Unit,	Post-harvest	6

Noosh Iran Company	Research and Development Unit	Apple, peer, grapes	5
Pak Dairy Company	Research & Quality Assurance	Dairy	29
Mazandaran Wood and Paper Industries Company	R&D Department	Forestry, industry	12
Rafsanjan Pistachio Producers Cooperative Company	RPPC Laboratory	Pistachio, post-harvest	3
—	Mimas Company	Post-harvest	5
—	Hashtgerd Premix Manufacturing Company	Dairy, poultry, fisheries	11
Shahdiran Inc.	R&D Department	Post-harvest	4
Shirin Knorasan Agro-Industry Company	R&D Unit	Sugar beet	13
Jovin Agro-Industry Company	R&D Unit	Crops, fisheries	25
Iran Dairy Industries Company	R&D Department	Dairy	17
Kalleh Dairy Company	R&D Unit	Dairy, post-harvest	2
Dashte Morghab (Yek and yek) Company	R&D Umit	Citrus fruit, tomato, cucumber	6
Novin Saffron Company	R&D Unit	Saffron	12
Gyah Company	R&D Unit	Fertilizers, herbicide, pesticide	10
Malard Mushroom Company	Research Center	Mushroom	2
Tarvand Saffron Ghaen Company	R&D Unit	Saffron	6
Dam and Darya Company	Pounel Group R&D	Beef, fisheries, pastures, forages	6
Telavang Company	Research and Scientific Group	Poultry	6
—	Fara Roshd Zagros Company	Beef, dairy, poultry	2
Havourash Company	BPIG Fisheries Department	Fisheries, post-harvest	10
Green Biotech Ltd.	Applied Microbiology Group	Crops	6
Isfahan Sugar Company	R&D Unit	Sugar beet, post-harvest	12
Sirjan Bonyad Agricultural Company	R&D Unit	Pistachio	9
—	Fajr-Sari Horticultural Company	Fruits	4
Dashtenaz Agricultural Company	Agricultural Research and Development Unit	Crops	4

Agro-Industry Experimental Farm	Research and Training Unit	Wheat, barley	2
Razavi Dairy Products Company	R&D Unit	Dairy	2
Kenebist Razavi Agriculture and Animal Husbandry	Research Unit	Livestock	3
—	Golbarg-e-Tooba Company	Ostrich	8
Damdaran	Teen Company	Dairy	15
